CHEMICAL & METALLURGICAL ENGINEERING

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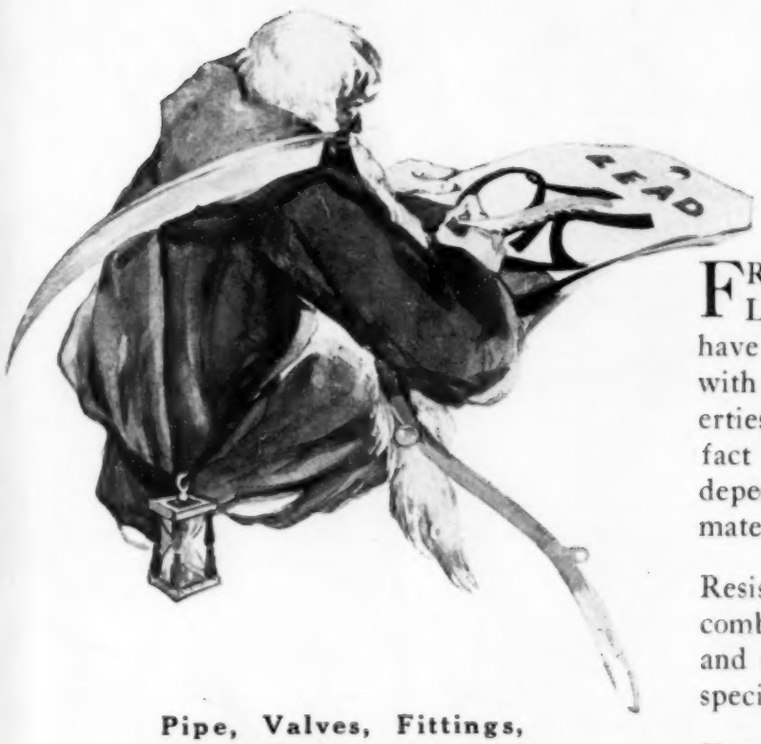

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CHEMICAL & METALLURGICAL ENGINEERING

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H. C. PARMELEE
Editor

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Engineering Education At Columbia University

IT APPEARS that our editorial announcement last week of the abolition of 6-year engineering courses in Columbia University was both premature and incorrect; premature in that a faculty resolution had not yet reached the university council for final action, and incorrect in that the faculty did not propose to abolish the 6-year course. It did, however, propose to modify the requirements in the pre-engineering course in Columbia College and to award a B.S. degree at the end of the second year of the regular 3-year professional course in engineering. The requirements for students entering engineering from institutions other than Columbia College are unchanged. While our statement of fact was incorrect, the editorial reflected a group of opinion within and without Columbia as to the wisdom and possible consequences of modifying pre-engineering requirements and awarding a B.S. degree in the engineering school.

We hasten to make the correction because, in our constant advocacy of 5-year and 6-year courses for chemical engineering and our admiration for Columbia's high standards in engineering training, we should be the last to put that institution in a wrong light. We are officially informed and assured that not only is there no intention to abandon the existing 6-year course for engineers, which has been generously supported by the trustees, but that the proposed modification of admission requirements for the pre-engineering course is but one step in a plan to stimulate a larger flow of students into the professional courses in engineering. It is felt, moreover, that the intermediate degree of B.S. will be well suited to some students who cannot afford to complete the professional course, as well as others for whom it would not be advisable to go further than the second year in engineering.

For a year or more there has been a division of opinion among the engineering departments at Columbia, as well as among the alumni of those departments, regarding the wisdom of putting engineering on a professional basis by the adoption of the so-called 6-year courses. This has arisen primarily from a scarcity of students in some of the engineering departments, with a corresponding reaction on the part of the old alumni of those departments for a return to "the good old days of the 4-year course." Against this agitation for what would manifestly be a backward step the majority in the school of engineering have steadfastly set their faces. At the same time the authorities are confronted with the practical problem of obtaining a sufficient number of students to maintain and support engineering instruction on a professional plane.

However the other departments of engineering may have fared under the existing plan, chemical engineering has prospered. The quality of the course has attracted students in spite of the strict requirements. If the department and its friends now look askance at any apparent lowering of standards for the benefit of other departments, it is only an evidence of their desire to maintain a reputation already won against great odds. The course will be continued on the same basis as heretofore. As for the wisdom or unwisdom of the plan proposed to stimulate attendance, we can only express the hope that, if it is approved by the council, it will result in the needed support for the professional school of engineering.

American Supremacy In Chemical Warfare

CHEMICAL warfare has recently found in the person of Leon Trotzky a friend of rather questionable value. In addressing a convention of scientists in Moscow on May 13, the Soviet Minister of War urged the reorganization of the Russian chemical industry as the first step in developing a chemical warfare service for that country. He cited American progress in this direction, incidentally declaring that Edgewood Arsenal was at present capable of producing more poison gas than could the entire German chemical industry even at the peak of its war-time production.

Strictly speaking, of course, the latter statement is not true, for while the United States is well in the lead in matters of chemical preparedness, there has been no striking expansion of productive capacity at the arsenal since the war. However, bringing the question of American supremacy in chemical warfare into the limelight at this time may serve a very useful purpose. The fact is well known, in technical circles at least, that the Chemical Warfare Service has had, and continues to face, some very serious problems of its own. It suffers not only from the scant appropriations obtained from Congress with the greatest difficulty, but there is also the internal problem of military organization and direction as they bear on chemical research. Obviously the War Department runs into difficulties in attempting to militarize completely a service that must of necessity depend in a large measure on the prosecution of scientific investigation. Civilian personnel must be employed for this work since the intensive training and experience required can seldom be found in a line officer or an enlisted man. The War Department's attitude toward civilian employees, perhaps too well known to receive comment here, is always characterized by the strict enforcement of oppressive civil service regulations, a discouragingly low scale of salaries and a mass of red tape that saps initiative and enterprise. Lately all of us have observed the exodus of technical men, many of them of unusual and invaluable experi-

ence, who have left the arsenal to take up work with the research and production departments of various chemical engineering industries. The cumulative loss of the experience and ability possessed by these men constitutes a real handicap to the Chemical Warfare Service.

General Fries appreciates, more than is generally recognized, the fact that the future progress of the Service under his direction depends upon the effective co-operation of the scientific and industrial organizations of the country. These agencies can render valuable service in two ways: First, by convincing Congress that adequate appropriations must be given in order not only to maintain Edgewood Arsenal in an efficient, standby condition, but also to further the necessary investigational work; and second, by impressing upon the War Department the vital need for a more liberal policy toward the civilian employees upon whom the Service must depend for the future development of better means of offense and defense.

Eliminating the Worthless Patent

A PATENT attorney of our acquaintance once boasted that, had he a mind to, he could get a patent on anything. To be sure, the courts might not recognize its validity, but nevertheless he would at least have had the satisfaction of getting it through the Patent Office. At the time we were inclined to disregard the implication of this idle boast, but recently in looking over a number of issues of the *Official Gazette* it came back to us most forcibly. We recalled it particularly in glancing over specification 1,488,009, describing an alleged substitute fuel oil, more specifically "a refined substitute gasoline for internal combustion motor uses." The first of two claims reads as follows:

1. A fuel oil comprising a fractional mixture of 3 quarts of water, 2 ounces of glycerine, 2 ounces of soap, 3 pints of crude oil, 3 pints of gasoline, 2 quarts of kerosene, 1 pint of ammonia, 3 ounces of ether, 3 pints of naphtha and 3 ounces of alum boiled to a viscous consistency to cause said gasoline, ammonia, naphtha and ether to evaporate therefrom, to provide a 2½ gal. mixture, diluted with one part of crude oil and two parts of gasoline to provide a 25 gal. mixture.

The original patent contained even more interesting fuel technology, so we decided to make a little investigation. As a result we discovered a number of things about the credulity of human nature as well as the fine art of patent law procedure. The inventor, if such he may be called, proved to be a stationary engineer, educated in the school of hard knocks, but sincerely certain of the efficacy of his epoch-making discovery. When the idea first came to him he sought the counsel of the priest of the parish, and it was at the latter's suggestion that together they took the proposition to a local attorney. A company was incorporated and application was made for a patent to be assigned half to the new company and half to the inventor. In addition to his legal services the lawyer very willingly agreed to supply the new company with one of its necessary raw materials—"water-white crude oil"—at a cost of 4c. per gal. ex-barge. And from time to time the attorney presented bills for various assessments and legal fees, amounting in all to approximately $800. These were paid by the inventor, the priest and a third friend who had joined in the corporation. But after waiting several months for the lawyer to make good his contract in respect to the oil, the inventor and his friends became suspicious, appealed to the district attorney and finally under threat of suit were able to recover a considerable part of the new company's ill-advised legal expenses.

All of this, while interesting from the purely human standpoint, is quite beside the question except for the reflection it casts on the unscrupulous methods of the patent attorney. He took advantage both of the ease with which a patent can be obtained and the fact that once it is granted the average layman is inclined to regard it as official approval and protection.

It is hoped that some day through the process of costly experience the public will have learned its lesson in regard to the value of a patent. In the meantime, however, we can well afford to search out and correct the underlying evil in our patent law that permits the constant repetition of this sort of deception. Some day we may want to change the Patent Office from a mill in which $1,800 clerks are grinding out grist for $20,000 patent lawyers. We may even find it desirable to revise our definition of patentability in such a way as to make it possible to separate the wheat from the chaff, to cull out the worthless and fraudulent and to make the granting of a patent mean something more than mere novelty and lack of interference.

Underrating the Chemical Engineer In the Rubber Industry

SKEPTICISM exists in certain quarters of the rubber industry concerning the usefulness of the chemical engineer. The old conservative idea still prevails that the industry stands alone, aloof from all others, and that the key to its progress lies in applying pure chemistry rather than the principles of chemical engineering. Undoubtedly this is partly because organic and physical chemistry underlie the art of compounding—probably the most important single step in rubber manufacture. On the other hand, those who decry the chemical engineer ought to realize that the actual technology of production should be his job. In our judgment it is unfortunate that in some plants no chemical engineer is employed; that in one of the largest only one man bears that title. Even in this plant his work is borderline in nature, not striking at the problems that should be recognized as within his province. Where this order prevails it is not strange that the chemical engineer passes largely unappreciated as a valuable means of increasing efficiency in production; that the chemist is glorified to such an extent that his engineer brother remains in obscurity.

The situation seems increasingly difficult to justify when a few of the major production operations of the rubber industry are considered. Milling undoubtedly tops the list as being most important. Here the various materials that are to constitute the finished product are brought together and worked into a composite mixture. The process involves close temperature control, handling of a difficult material, mixing under unusual conditions and accurate time control. As generally conducted, the standard two-roll mill is used. Refrigeration of these rolls is an engineering problem of the first order. Further development of this prevailing type of mixer as

well as the introduction of new apparatus like the kneading type is hindered by difficulties the ironing out of which is within the province of the chemical engineer. Again, a wide diversity of opinion exists as to the best manner of washing and drying raw rubber; chemists, practical men and mechanical engineers are not in close accord. Here are two of the unit processes of chemical engineering, yet these operations are not so recognized in the rubber industry. Gum-dipped goods introduce the problem of solvent recovery. Market conditions, however, make such recovery a questionable practice. Whose job is it to direct this operation but that of the chemical engineer? Again, the question of water dispersion is open. Has this development a bright commercial future or is it but a flurry that may soon be forgotten? Let the chemical engineer decide.

It is not intended to underrate the contributions that chemists are making to the rubber industry. Much remains for them to do, but in the same way the chemical engineer will contribute much to future advance in the technology of the industry if the proper opportunity is given him. The rubber chemist who scoffs at the chemical engineer, and there are many such, displays a lack of perspective that is not conducive to the major interests of the industry. There is no place for skepticism, either open or concealed, as to the benefits that may accrue from the intelligent application of the fundamental principles of chemical engineering to the problems of the rubber industry.

Mixing Chemistry and Business Into the Art of Varnish Making

MAKING varnish according to rule of thumb dates back to the days of the early Egyptians, yet the industry did not make real progress until it added to its formulas two new ingredients: Business foresight and chemical engineering. Here is the story as we have it from Prof. A. H. Sabin, respected dean of paint technologists and himself a pioneer in the American varnish industry:

In 1867 a young business man of Boston came into possession of an alleged varnish factory on the Charles River. After he had inspected his acquisition of questionable value and had watched the mysterious artisans cooking their secret concoctions, he returned to his office with one thought firmly fixed in his mind. This was that varnish making was, or should be, a chemical industry and that chemical brains would have to be mixed with the business in order to make it succeed. There were no chemical engineers in those days—by that name at least—and the industrial chemists were few and far between. But the young business man had heard that the Pacific Mills had in its employ Charles F. Homer, a Harvard graduate who had proved a very capable chemist. And the mill thought so highly of its chemist that it paid him $4,000 a year—a fabulous salary in those days and indeed not so far beneath the dignity of many members of the present-day profession. The new owner of the varnish factory felt too prosperous, however, to be easily discouraged and he approached Mr. Homer with an offer of $5,000 and a 5-year contract. It was attractive, to be sure, but the chemist finally turned it down, complaining that he knew nothing about varnish manufacture and wasn't sure that he cared to learn. But this, it seems, did not settle the argument, for in a short time the young varnish capitalist was back, this time with a tender of $6,000 and a 10-year contract. After long persuasion Mr. Homer decided to cast his lot with the new enterprise, not knowing, as he said, which took the more nerve—to make the proposition or to accept it.

The combination of the chemist and the business man proved successful from the start. In a few years a domestic varnish superior to the best English coach finish appeared on the market and has been in increasing demand ever since. Other new products were developed and, as the coach gave way to the automobile, the business expanded enormously and branch factories were established. The fusion of chemistry and business proved so close and so effective that now, two generations later, we find Charles F. Homer's position as chief chemist of Valentine & Co. being ably filled by the grandson of the business man whose foresight helped to provide the sound chemical engineering foundation on which rests the modern varnish industry.

Wonder What's Doing in Stamford?

IT was O. Henry that asked the same question about Louisville and then told a delightful story of what might have happened there. So we might ask, What do they do in Stamford except make brass and locks and such things?

For one thing the Stamford Chemical Society held its annual dinner last week. It should have been broadcast to every chemical engineer, chemist and operating man, for there was a keynote to the speeches that should make a deep, stirring appeal to each individual. The civic and social responsibility of the chemical engineer was discussed with conviction and definiteness that were free from the vague generalities that usually fog such discussions.

A distinguished lawyer placed the problem of government squarely up to the engineers of the community. Government in this country is passing through a crisis, yet technical and scientific men draw their togas closely about them and remain in recluse-like obscurity. They are unwilling to insure the very prop of civilization, for where would science or engineering be without government?

The president of the Chamber of Commerce told of the pressing problems where scientific methods of thinking are essential—schools, assessments, co-ordination of city and town government. These problems need the engineer.

A prominent red-blooded clergyman challenged the technical men to attend to that most elementary civic duty, the ballot. Technical men in particular are the beneficiaries of a generous society, for at least 50 per cent of their education is a gift from the community by scholarships, endowments and taxes. They must do their part. Twenty civilizations built on economic and political foundations have already failed. Let the technical men, then, help to create a civilization based on a scientific and spiritual foundation.

What are they doing in Stamford? They are thinking—thinking in a way that is preliminary to action. They are preparing for the active, constructive citizenship that should be the privilege as it is the duty of every man.

Co-operation—Catalyst of Industry

The Principles of Trade Association Work Presented by the President of the National Lime Association Should Be a Guide and a Challenge for Co-operation

"THESE annual conventions of our association, the national organization of our important basic industry, may be considered as milestones marking the advancement of our united progress along the road which leads to the ultimate goal of accomplishment and leadership. Reward for our efforts should not be measured by reflected profit to ourselves alone. We should always have in mind our duty as a national institution to render a maximum of useful service to the public and also to the thousands of workers whom we collectively employ."

Trade associations exist for a variety of reasons and in the past there undoubtedly have been organizations that pushed an industry forward with too great diligence and too little regard for public welfare. That is the fire behind the great volume of smoke caused by the government investigation of association work. Investigation and the concomitant notoriety and suspicion have handicapped and hindered the good associations along with the bad. It is to be hoped that we are in a new era now—an era in which the great benefits of trade association may be shared alike by the industry and the public and that the few evils will be self-curbed.

It is certain that if associations will bear constantly in mind the words quoted above, the results will be beneficent. "Reward not in profits alone but in rendering a useful service as a national institution to the public." It is both an ideal and a guide for association work. It is more significant as a practical guide to association policy. It is almost inconceivable that a policy that does not take cognizance of public benefit will be long successful. Temporary advantage may accrue to an industry by advertising its product for a use that is not to the ultimate advantage of the public or by suppressing disadvantageous information. But in the long run public interest will prove a sound principle of policy.

George B. Wood

There is little need to call attention to the value of association work. It is apparent to those who are even remotely connected with it. There is a dramatic example of it related in the speech of George B. Wood, president of the National Lime Association, from which the previous quotation was also taken.

"Before the war 90 per cent of the business of the walnut lumber manufacturers was export. During the war the entire production was used for gun stocks and airplane propellers. At the end of the war the export business was dead and the American Walnut Manufacturers Association commenced a co-operative advertising and publicity campaign. Today the volume of business is greater than before the war and 90 per cent of the product is consumed in American markets for furniture and cabinet work. One half of the industry has paid the bill, the other half has shared equally in the benefits, but the industry was saved."

George B. Wood, president of the Rockland & Rockport Lime Co. and president of the National Lime Association, is one of the leaders of his industry, and his foresight and influence have been great in gaining the hearty co-operation of his fellow manufacturers. His address at the recent convention of the association should stir his whole industry to an enthusiastic indorsement of his policy.

Cane Sugar in Cuba

The First of Two Articles Discussing Conditions Under Which Cane Is Cultivated and the Chemical Engineering of Raw Sugar Production—This Article Takes the Process Through the Defecation of Juice

By Albert M. Young

Formerly Chemist, Central Control Laboratory, Cuban-American Sugar Co., Cardenas, Cuba

A SIX HOURS sail from Key West, Fla., lies the city of Havana, the gateway to Cuba and, as regards tonnage of foreign commerce, the second port in the Western Hemisphere. It is a compact and clean little metropolis of about 375,000 people. With its narrow streets darkened by overhanging balconies and awnings, its sunlit parks and beautiful drives, it is a most picturesque and interesting city to the tourist.

Through the gateway of Havana lies the hinterland of Cuba, and after leaving the ultra-modern capital the traveler must become reconciled to poor roads, to indifferent railroad service and to hotel accommodations that leave much to be desired. In provincial hotels, for example, a room with a private bath is a rarity.

The average American is apt to think of Latin-American countries as lands of turmoil and perpetual revolution. Although Cuba revolted many times against Spain, it may fairly be said that American political supervision of the island since 1898 has been so tolerant and so liberal that Cuba will not soon experience anything in the nature of a general revolution.

Hence the sugar industry is free to develop without fear of revolutionary disturbances. It may be said, however, that on account of a natural feeling of resentment against North American domination of Cuba's one great industry, the Cuban Government sometimes tries to embarrass and to restrict American enterprise. A case in point is the recent tarafa act by which the attempt was made (with partial success) to impose a tax on sugar shipped through ports developed and owned by some of the sugar companies.

The production of the Cuban sugar industry is far ahead of that of any other country. In the year ended August, 1923, the world production (including both cane and beet sugar) was about 19,000,000 long tons. Of this Cuba produced 3,600,000 tons, or nearly one-fifth. The previous year Cuba produced more than one-fifth of the world's sugar.

Fig. 1—Typical Stand of Cane at the Central Macareño

Fig. 2—Morro Castle
The famous fortress at the entrance of Havana Harbor.

Cuba's title as "Pearl of the Antilles" is due to her remarkable soil and climate. As Cuba lies wholly within the tropics, it is a natural home of the sugar cane. The Cuban planters, with a minimum of effort, produce crops that are among the heaviest of the world. Although Java and the Hawaiian Islands yield more sugar per acre, they do so only by costly methods of forcing; in Java by the use of fertilizers and in Hawaii by irrigation. Neither of these methods is practiced extensively in Cuba.

As an illustration of Cuba's splendid natural endowment, consider the fact that it is customary there to expect profitable cane crops from a single planting for 5 to 6 successive years. On the newer lands nine to ten such crops may be expected.

Parenthetically it may be of interest to note that sugar cane is propagated by planting the joints (nodes) of the stalk. After the harvest of the first crop (which occurs 9 to 15 months after planting), the roots send forth new leaves that develop into the crop for the following year. This process could be repeated indefinitely were it not that the sugar content gradually diminishes. Each crop after the first is termed a "ratoon."

Compare this prodigality of production with conditions in our own Louisiana, the only important cane region in the United States. In Louisiana after the first "ratoon" it is usually necessary to sow the land to cow peas or clover for a year or two in order to restore a supply of nitrogen to the soil. We do not suppose for a minute, however, that Cuba's great fertility will continue unimpaired unless a greater effort is made to preserve the nutritive elements of the soil.

Fig. 3—A Cane Cutter at the Central Macareño
Notice the broad knife or "machete" that is commonly used.

As a complement to her wonderful soil, Cuba has an ideal climate for cane culture. The hot summer with frequent rains provides a proper growing season; and the cool, dry period from December to May is particularly favorable for the ripening of the cane and for its harvesting.

Cane Culture—the Colono System

The actual growing of the cane is largely in the hands of comparatively small farmers, or "colonos" as they are called. "Colono" is a Spanish word meaning "colonist." The colonos may own the land they plant or they may hire it for a nominal sum from the sugar company. At any rate, the colonos act as independent units, carrying their own expenses and receiving their pay in sugar or its equivalent. The company usually contracts with the colono to return to him the sugar equivalent of from 4 to 7 per cent of the weight of the cane he delivers at the railhead. Thus, as the total yield of sugar is about 10 to 12 per cent of the weight of cane ground, the share of the sugar company amounts to about 5 lb. of sugar for every 100 lb. of cane treated.

The colono may be paid in one of two ways. By the first method he is given warehouse receipts of the seaboard warehouse where the sugar is stored pending shipment. By this arrangement he can sell the sugar at the time the market seems most favorable. The largest sugar companies, however, usually avoid this temptation to "play the market" by selling their sugar as fast as it is made. Raw sugar does not keep satisfactorily much longer than 6 months or a year.

The second and more usual method of liquidating the colono is to pay him twice monthly in cash the average sale price of sugar at the port of shipment during the previous 2 weeks.

The campaign in Cuba begins about the middle of December, although many of the centrals (the usual name for the raw sugar factory) do not commence grinding until well into January. In spite of the fact that the cane does not become well ripened until March, the operators wish to start early in order to produce the maximum amount of sugar before they are compelled by the heavy rains in May to close down the factories.

Cane is always harvested by hand and the field laborers are often low caste Haitian or Jamaican negroes, who are lazy, shiftless and irresponsible. With the harvesting comes one of the most serious problems of the sugar manufacturer, that of transportation. The cane is very heavy and as it readily suffers loss of sugar (sucrose) by inversion, it must be moved to the mill as soon as possible after cutting. Figs. 4 and 5 illustrate an important if primitive method of transportation. These ponderous two-wheeled carts drawn by six or eight stolid oxen appear clumsy enough; but they offer the best means available for drawing heavy loads (about 6 tons) over soft ground. The march of progress is evidenced even here, for caterpillar tractors have been introduced with some success.

At the railway the cane is transferred from the bullock cart to the railway car, as illustrated in Fig. 6. Nearly all of the cane has a railroad journey before it reaches the sugar mill, and on account of the great size of some of the estates the length of this journey may easily reach 30 to 40 miles. Some of the largest companies own and operate standard gage railroads for this service.

Raw Sugar From Cane

As we have seen, the manager of the sugar mill relieves the colono of responsibility when the cane is delivered and weighed in at the railhead. Let us follow the process up to the time the "raw sugar" is shipped

Figs. 4 and 5—How the Cane Is Moved to the Railroad
Caterpillar tractors have been used with some success, but the ox still holds sway. These carts weigh between six and seven tons when completely loaded.

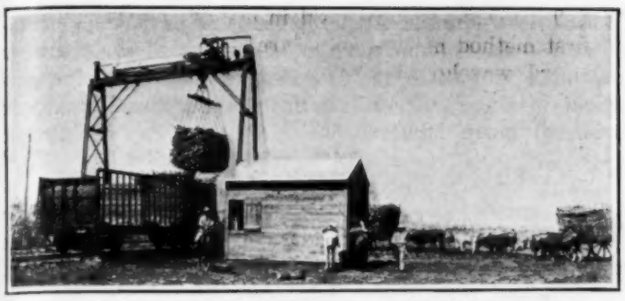


Fig. 6—From the Ox Cart to the Railroad Car
A step in the transportation of cane to the central or sugar-extraction plant.

to the Northern refineries. (See the flow sheet, Fig. 7.)

The manufacture of raw cane sugar consists essentially of seven steps: (1) The juice is crushed out of the cane by means of powerful mills, (2) the expressed juice is subjected to a partial purification to remove the impurities that interfere most with the crystallization, (3) the purified juice is evaporated in multiple effect evaporators to the consistency of table sirup, (4) graining is carried out under very careful control in the single effect, (5) the crystals of raw sugar are separated from the molasses by centrifugal action, (6) the molasses is reboiled to recover more of its sugar, (7) the sugar is packed for shipment.

When the cane train arrives at the sugar mill, the cars are run singly upon a platform and tilted by hydraulic pressure so that the cane easily slides off. It is received upon a conveyor and carried into the factory to a point directly above and in front of the first member of the "tandem." An operative feeds the cane into the mill system at the rate desired by controlling the speed of the conveyor.

Milling of the Cane

The three-roller mill, the standard of modern practice, is so constructed that the axes of the three rolls form an isosceles triangle. The rollers are supported on their bearings by central shafts, at one or both ends of which are massive tooth gears intermeshing in such a way that the power from the prime mover to the top roll is transmitted in turn to the two lower rolls. These two rolls are fixed in a rigid horizontal plane, whereas the upper roll is free to give in case of extraordinary opposition. The upper roll is held in place by a load of 400 to 500 tons (hydraulic pressure) for a 7-ft. mill.

The surface of all the rolls is deeply channeled with criss-cross grooving to prevent slipping of the fiber and to promote the ready escape of the juice.

A complete installation consists of three to six three-roller mills joined in a "train" or "tandem," and a pair of pre-crushing or shredding rolls is usually made a part of the system. The horsepower allowance for a three-mill tandem is 200 for each mill and 150 for the crusher, a total of 750 hp. Unless motors are used, the power is supplied by a single Corliss type engine through speed-reducing gears. The engine speed of about 45 r.p.m. would have to be reduced to 2 r.p.m. in the mills. Electric motors, used to some extent, are applied to each mill individually.

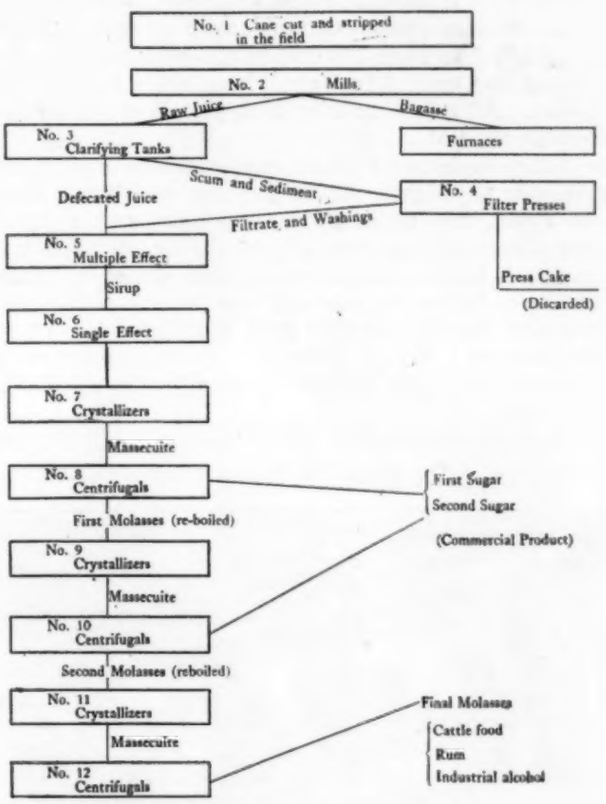


Fig. 7—Flow Sheet of Raw Sugar Mill

The spacing or "opening" between the top and the front roll of the first mill is about 1½ in., while that between the top and back rolls of the same mill is about 1¼ in. The opening is gradually decreased in the successive mills until the top and back rolls of the last mill are set "iron to iron." Thus the fiber in passing through the system is crushed from six to twelve times according to the number of mills at constantly increasing pressures. The "trash turner," filling the space between the two lower rolls, prevents the fiber from being forced out at the bottom of the mill and also acts as a scraper for the front roll.

To aid in extracting the sugar a limited amount of water (termed maceration or imbibition water) is sprayed on the fiber between the successive mills. The fiber as it expands from a previous crushing takes up water like a sponge. Then as the pressure is again applied, this water is pressed out, carrying with it a

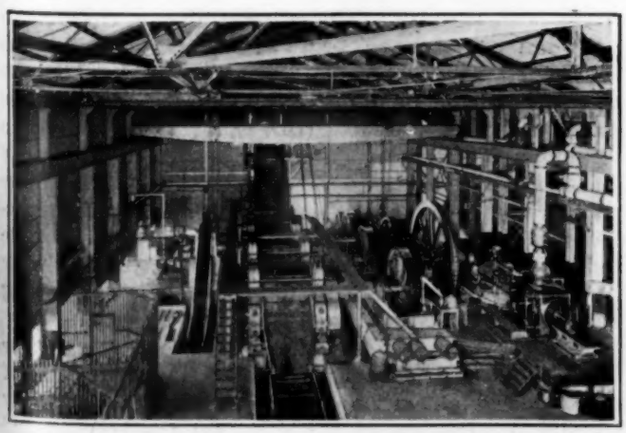


Fig. 8—A Sugar Mill Tandem
Series of mills at the Central Macareño for crushing and extracting the cane. Note the driving mechanism and the crane for removing the rolls.

certain amount of sugar. Under working conditions the mills extract 90 to 95 per cent of the sugar originally present in the cane. Fig. 8 shows the general appearance of the tandem, of which some factories contain as many as three.

The expressed juice is strained to remove the larger particles of fiber and is then pumped to the tank scales, where it is sampled and weighed.

Bagasse Utilization

The spent fiber (called bagasse) from the mills is carried by a conveyor to the furnaces and burned under the boilers. With the bagasse goes 5 to 10 per cent of the original sugar that was not extracted by the mills. This is the first manufacturing loss.

The modern process of cane sugar manufacture may be said to date from 1880, when green bagasse was first successfully burned in Hawaii and in the British West Indies. At this time also multiple effect evaporation became general.

Although bagasse feels comparatively dry to the touch, it contains about 50 per cent moisture. Hence the direct burning of it presents considerable difficulties. Bagasse furnaces are of the Dutch oven type, having a large external combustion chamber. Check walls and baffles promote thorough mixing of the gases and reflect waste radiant heat that helps to dry out the bagasse. Fig. 9 shows the conveyors and chutes through which the bagasse is fed into the combustion chamber.

The calorific value of green bagasse (45 per cent water) is given as 4,500 B.t.u. per pound. This is

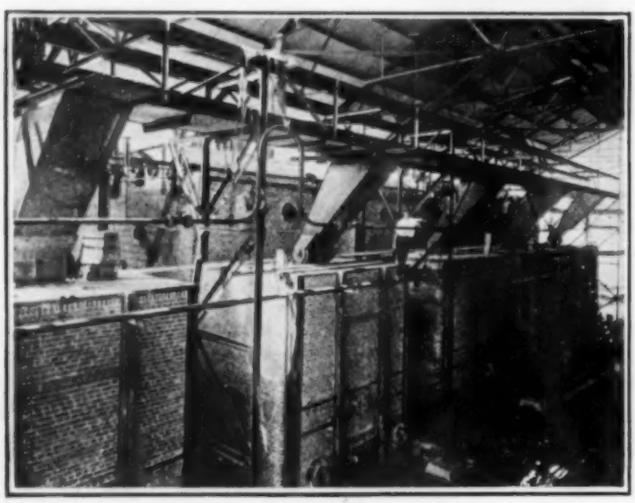


Fig. 9—Boilers Burning Bagasse
Note the bagasse conveyors and chutes. This is the boiler house at the Central Macareño.

about equal to the value for air-dried wood (25 per cent water). The amount of bagasse produced is nearly sufficient to supply the power requirements of the sugar house. The deficiency (0 to 5 per cent) is made up by the use of fuel oil or wood.

Although there have been proposals to convert the bagasse into paper instead of burning it, at the present time little is being done in this direction. Bagasse is too bulky to transport economically and, with a few possible exceptions, not enough is produced in one locality to warrant the operation of a paper mill. Furthermore, bagasse yields a rather poor grade of paper. On the other hand, a building board called "Celotex" (see *Chem. & Met.*, Aug. 27, 1923) is now being manufactured in Louisiana from bagasse, and it is always possible that some such development may become possible in Cuba, where the units of production are in general much larger.

Clarification or "Defecation" of the Juice

Defecation, as practiced, is a crude but surprisingly effective method of treating the raw juice to remove the most objectionable impurities. By the action of heat and slaked lime the colloidal matter of the juice is

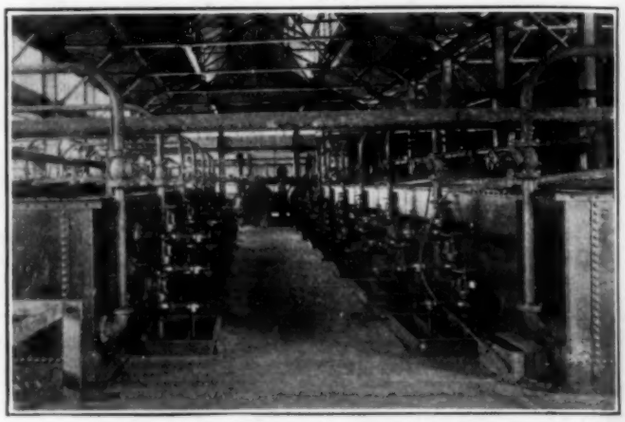


Fig. 10—Defecators for the Sugar Juice
Here the sugar juice is treated with lime and settled, the clear juice being drawn off at the different levels indicated by the draw-off pipes. A single Dorr clarifier will replace this cumbersome equipment.

coagulated. The resulting precipitate settles rapidly and leaves a relatively clear, "negotiable" juice, 90 per cent of which can be run to the evaporators without disturbing the sediment. The sludge is filtered to recover the remainder of the juice, the press-cake being discarded.

Defecation is carried out roughly as follows: The juice is pumped after weighing into open rectangular tanks (Fig. 10), in which it is treated with milk of lime to neutrality or to faint alkalinity. The limed juice is then heated to 190-212 deg. F. by steam coils inside the defecators. Heating is continued until the scum "cracks," after which the precipitate will settle readily. Notice in Fig. 10 the outlet pipes placed at different levels so that as the settling progresses the clear juice can be drawn off in steps from the surface layer downward. The sludge remaining in the tank is then filtered through plate and frame presses such as those shown in Fig. 11.

In factories having adequate filter-press capacity the first press-cake is diluted with water and refiltered to effect a partial washing of the cake. Under Cuban conditions, however, the factories are usually run above their rated capacity so that double pressing is impracticable. The loss of sugar in the unwashed press cake amounts to about 1 per cent of the sugar originally present in the cane. By dilution and double pressing this loss can be reduced to 0.25 per cent.

The problems of defecation are primarily chemical or physicochemical in nature; and as the chemistry of cane juice is little understood, the process is largely empirical. Because of the fact that the keeping and refining qualities of raw sugar depend to a large degree upon the efficacy of clarification, I believe that sugar manufacturers should lay more stress upon this part of

the process. As raw sugar has never been sold on a quality basis, there has been little incentive to produce a grade of sugar suitable for economical refining. Consequently great losses have been suffered by bacterial decomposition that can be traced to poor defecation.

The crux of the problem of proper defecation lies in the use of exactly the right amount of lime—that is, the attainment of the correct degree of alkalinity. If the juice be underlimed, the precipitate does not settle readily and there is danger that free acid present will cause the inversion of sucrose. If the juice be overlimed, the free alkali destroys glucose, with the formation of objectionable coloring matter. The latter of course increases the troubles of the refiner. Furthermore, the excess of lime tends to foul the coils of the evaporators.

The aim of the superintendent should be to add enough lime to bring the juice as nearly as possible to the neutral point, but a slight alkalinity is permissible.

The neutral point is best determined by the use of chemical indicators. The chemistry upon which their

Fig. 11—Filter Press Station at the Central Macareno
Filtration in raw sugar mills is almost universally carried out in plate and frame presses. The newer type of filter such as the rotary suction type have not been introduced.

use depends may be stated as follows: By definition a solution is neutral when its hydrogen-ion concentration is equal to 10^{-7} (mols per liter), the concentration of hydrogen ion in pure water. Since litmus paper changes color at concentrations of hydrogen ion slightly above or below 10^{-7}, it is regarded as a suitable indicator of neutrality as defined. Litmus paper has not been much used, because its color change is rather difficult to see, especially in the absence of strong daylight. It should be of interest to note, however, that an improved variety of litmus paper is now sold. The success of this paper depends upon the fact that it is hardened or parchmentized so that it is not wet through by the liquid tested. Thus there is no color change simply from wetting. Still the use of litmus paper is difficult and it is not reliable in the hands of native laborers.

Phenolphthalein has a marked and obvious color change at concentrations of hydrogen ion between 10^{-8} and 10^{-9}. Because of the convenience in the use of phenolphthalein, the common practice has been to titrate the acidity of the raw juice using this indicator, and then to make a correction for the fact that phenolphthalein does not change color at the neutral point. A quantity of lime corresponding to the corrected titer would then be added to the juice.

But in some localities the juices contain amino-acids in such amount or rather perhaps of such character as to vitiate entirely the results obtained from phenolphthalein. To obviate this difficulty A. H. Allen has recently recommended the use of corallin as an indicator, and he has shown that in the case of one factory (in Porto Rico) corallin gave satisfactory results (*La Planter*, Aug. 25, 1923).

Potentiometer measurements of hydrogen ion have been tried but not perfected. In practical work the superintendent is guided to a large extent by the appearance of the juice, by its odor, and by the manner in which a small sample of it settles when observed in a test tube. For purposes of comparison if for no other reason, a rigid system of chemical control would be preferable to these empirical methods.

Modern equipment is finding its way into the defecation and clarification process and it is with a consideration of this subject that the second half of this article will commence in a subsequent issue of *Chem. & Met.*

Using Internal Heating for Low-Temperature Carbonization

An Account of Several Important Processes That Have Not Been Previously Considered in This Series

By C. H. S. Tupholme
London, England

Low-temperature carbonization systems are about evenly divided between the use of internal and external heating. Those best known, such as the Coalite and Carbocoal processes, use the external method. In Great Britain, however, there are many examples of the internal method in use. Several of these, notably the Maclaurin and Nielsen retorts, have already been described in this series. In the present article the author describes several additional systems that use this procedure.

IN several preceding articles I have described the principal systems for the low-temperature carbonization of coal that are now attracting attention in Great Britain. There are, in addition, several processes that have so far received less attention, but that hold out sufficient promise to make a description of them worth while. The following paper will, therefore, be devoted to an account of the processes of Everard Davies, Illingworth, Koppers and Plauson.

How the Davies Retort Works

The general principle of the Everard Davies process may be stated essentially as carbonization, with or without accompanying gasification by steaming, of such

fuels as bituminous coals, brown coals and lignites. Temperatures range from 800 to 1,600 deg. F. The retort is a continuous vertical type, heated externally on one side only, but heated internally by a small portion of the heating gases passing through the descending charge in a direction transverse to the charge length —that is, through the charge thickness. The external heating combustion chambers are in three or four horizontal zones, and the retort is under slight suction, or intensified suction if the carbonizing requirements so demand.

The system is thus designed to combine external and internal heating with the view of deriving the advantages of both methods. Up to about 25 per cent of the heating flue gases, after being spent by external heating, are passed through the descending charge in the retort. This action improves the rate of heat transmission and absorption and increases the throughput of the retort. The charge conditions are readily and simply manipulated to permit an easy passage of the gases when, for instance, a very strongly caking coal is being used. Under these conditions the heat transmission at 1,100 to 1,470 deg. F. is more rapid than in externally heated retorts operating at 2,000 to 2,250 deg. F.—that is, 1 in. per hour penetration at the maximum carbonizing temperature.

The swelling and frothing of coal under distillation generally begins around 660 to 750 deg. F. The chief difficulty with this action in externally heated retorts is that the slow heat transmission means that only 15 to 25 per cent of the total time of carbonization, when using a very expansive coal, is available for resolidification, the expansion taking place in one stage and jamming the retort. In the Davies retort this expansion may be graduated over two stages, which involves a less severe action, and the designer claims that from 30 to 50 per cent of the period of carbonization is available for resolidification even with a badly swelling coal.

Davies Commercial Installation

The Everard Davies commercial installation consists of twin vertical retorts built of fireclay or silica, according to the capacity required per unit area, together with such plant as coal screening, crushing, elevating and feeding apparatus. Charges of from 2 to 5 tons per retort or 4 to 10 tons per set of twin retorts can be dealt with without requiring that the charge thickness be increased beyond 2 ft. 6 in. This thickness, when using coals not wholly consisting of finely divided material and a highly conductive refractory such as carborundum for the fluework, permits a large throughput, whereas ordinary refractory can be used for a charge thickness up to 1 ft. 9 in.

The retort chambers are built up to 36 ft. in height, and from 5 ft. to 8 ft. 6 in. in length, and from 1 ft. 9 in. to 2 ft. 6 in. wide. Retorts over 30 ft. in height generally contain four stages, those under 30 ft. having either two or three stages. This zoned method of heating actually amounts to the superimposition one above the other of three or four retorts, each of which may be separately controlled.

The design of the heating system is such that by means of triangular flues having the base of the triangle in the retort wall, the flame of combustion of the heating gas is presented to a very large area of the retort wall. Together with the external system of heating is combined the arrangement for introducing the flue gases plus any extraneous gases such as steam, hydrogen, oxygen, air or water gas across the charge thickness. This gaseous mixture is highly superheated in the flues previous to its admission to the charge. The combined heating systems are restricted to one side only of the charge, the other side lying adjacent to an offtake for the withdrawal of the products of distillation. The external heating takes place only on the outside of the twin retorts, the offtake being located between the retorts.

The combustion chambers are in four zones: In the top zone the yield is gas, tar and tar oils; the second gives larger quantities of gas with a high proportion of methane; the third yields gas and ammonia; in the fourth the evolution of gas is completed and the charge is coked.

When using a fuel of 30 per cent volatiles, 5 per cent ash, 5 per cent moisture, 60 per cent fixed carbon, and of 14,000 B.t.u. per lb., the yield is 14.5 cwt. residual coke, 18 to 26 gal. of oil, 2½ gal. of motor spirit from the stripped gas, 4,000 cu.ft. of gas of 500 to 600 B.t.u. per cu.ft. and 30 lb. sulphate of ammonia.

From a coal containing 40 per cent volatiles and 50 per cent fixed carbon, with a calorific value of 13,000 B.t.u., this yield is obtained: 12 to 13 cwt. residual coke, 35 to 42 gal. of oil, 3 to 4 gal. of motor spirit from the stripped gas and 25 to 30 lb. sulphate of ammonia.

Everard Davies estimates his operating costs at around 26s. per ton, including coal at 15s. to 17s. 6d. per ton. He estimates the maximum revenue to be in the neighborhood of 40s. A plant to carbonize 200 tons per day will cost in Britain now about £80,000 to install.

Process Based on Chemical Research

One of the most interesting of the low-temperature carbonization processes is that evolved from purely chemical research by Stewart R. Illingworth. The process has for its object the conversion of coals that swell excessively into coals from which a dense smokeless fuel is easily evolved.

Illingworth has ascertained that all coals other than dry steam and anthracite—namely, all coals containing more than 12 to 14 per cent volatiles at 900 deg. C.—can be treated to produce coke, provided such a coal contains resinic material in sufficient amount. He classifies coals as follows:

Type 1, in which the humic, cellulosic and resinic substances decompose at or below 300 deg. C.

Type 2, which decompose at or below 350 deg. C.

Type 3, which decompose at or below 400 deg. C.

Type 4, which decompose at or below 450 deg. C.

The best types of coking coal contain relatively small amounts of type 2, large amounts of type 3 and small amounts of type 4. Gas coals contain these types, but the amount of type 2 is greater than in the coking coals, and the more volatile gas coals contain considerable amounts of type 1. If the gas coals are heated out of contact with air to 350 deg. C., coals of the types 1 and 2 will be eliminated, leaving a residue containing types 3 and 4, such a residue being suitable for coke production.

Illingworth therefore preheats coal to a temperature not above 500 deg. C. out of contact with air so as to destroy as far as possible the β cellulosic and resinic substances. The process is conducted at a temperature below that at which the coal forms a coherent mass, usually below 400 deg. C., so that a non-coherent prod-

uct is obtained, which can be charged directly into the retort for distillation at 900 to 1,000 deg. C.

As an example, a coal forming a hard coke and giving 30 per cent volatiles at 900 deg. C. was found to form coke structure at 360 to 380 deg. C. This coal was heated to 300 deg. C. for 2½ hours out of contact with air, and on the ash-free dry basis lost 2.5 per cent of weight, and no coke or sintered product was formed. The temperature was raised to 400 deg. C. and after a further 2 hours heating the additional loss was 2 per cent, with no formation of coke or sinter. This product had no coking properties above 400 deg. C., and not even when heated suddenly to 900 deg. C., though it retained the same appearance as the original coal. Thus it is possible fully to carbonize a coking coal by means of successive stages of heating—that is to say, all the volatile matter can be expelled, but no coke will be formed in the process.

The preheating may be conducted in a separate furnace, the material being transferred to a retort for carbonization. The heated gases evolved from a charge undergoing carbonization may be employed for the preliminary heating, the gases being cooled to the required temperature and then passed through the charge.

Carbonizing With Steel Balls

A method of low-temperature distillation that is attracting much attention just now is that devised by Heinrich Koppers, by which coal is carbonized by passing through its mass a number of preheated steel balls. These steel balls are introduced into the heating chamber together with the charge, the balls being preheated to the required temperature and being present in sufficient number to assure carbonization.

The retort consists of a revolving drum furnished inside with a worm that carries the fuel and the balls together from the feeding to the discharge end. It is also claimed that the steel balls prevent the caking of the charge during the period of plasticity. The balls, 100 mm. in diameter, are heated to about 800 deg C. in an adjacent furnace, and then are fed into the worm with the charge. At the delivery end the semi-coke is discharged through a screen into a hopper, while the balls pass out through a covered channel that conveys them back to the furnace for reheating. The drum and the ball channel are insulated to minimize radiation. Unfortunately I have not been able to secure any yield figures from this process, though I am told that great hopes are entertained of it on account of its cheapness. Personally I am inclined to doubt this cheapness, as the wear and tear on the conveying worm inside the drum must be considerable. I am also of the opinion that a high efficiency cannot be expected of any low-temperature distillation process operating under commercial conditions where there is inside the retort any part which moves about a fixed center or pivot.

In case readers of *Chem. & Met.* are not already familiar with it, some details may be given here of the method used by Fellner and Ziegler of Germany. The fuel, crushed to about 1 in. cube, is fed into a long, slowly revolving cylindrical retort, 65 ft. long by 8 ft. in diameter, made of steel, inclined at 1 in 20, the discharge end being the lower. This retort revolves at the rate of one turn in 3 minutes. Inside the retort is fitted a scraper consisting of a number of arms attached to a central revolving spindle, and extending from the feed end to nearly half the length of the retort.

The fuel is fed continuously at the rate of 3 tons per hour and is subjected to a temperature of 600 deg C. The heating, which is external, is carried out by producer gas or the low-temperature gas from the process, the volatiles and gas leaving the retort at 350 deg. C. From 1 ton of fuel a typical yield is 77 per cent smokeless fuel, 6.46 per cent low-temperature tar, 1.58 per cent motor spirit or benzol, 0.78 per cent pitch and 3,750 cu.ft. of gas. The low-temperature coke, containing 10 per cent volatiles, is either crushed and burned as a pulverized fuel or it is briquetted with a pitch binder. Alternatively it may be gasified in producers.

Using Superheated Steam

A process that is based on fundamentally different principles from those so far discussed is that of Dr. Hermann Plauson, an Esthonian. This process is based not on distillation but on mechanical driving off by passing through the fuel superheated steam or an inert gas at the rate of 300 to 600 meters per second, the steam carrying off the oils and other products with a high boiling point while their temperature is still under the boiling point.

The fuel is broken into 3 in. cubes and charged into a vertical cylinder, which has at 3 ft. from its lower end an annular ring carrying a number of nozzles similar to those used in steam turbines. The fuel is in a layer about 3 ft. thick, the steam being forced through under pressure and taken off at the top of the retort, where it passes into condensers. The steam is generated at 15 atmospheres pressure, and the lower end of the retort is water-jacketed to cool the coke, which is drawn off by a worm, and also to supply the boiler with preheated water.

The following are typical yields from this process;

1. Bavarian oil shale containing 6 to 8 per cent of bituminous matter is treated with expanded steam of 3 to 8 atmospheres pressure, superheated to 350 deg.–380 deg. C. The exhaust vapors show a temperature of 120 deg. to 160 deg. C. in the condensation space. A readily mobile crude oil of boiling point 140 to 300 deg. C. is obtained, and the residue is free, or practically free, from sulphur. Such oil shales with 8 per cent water content give a residue of 79 per cent. The crude oil obtained can be readily desulphurized and transformed into hydrocarbons of low boiling point which are water-clear and ready for use in internal combustion engines. English oil shale with a high bitumen content gives up to 20 per cent of crude oil, from which 70 per cent can be converted into fractions boiling below 200 deg. C.

2. Bituminous coal is treated in a similar manner. If a coal is taken that gives about 8 per cent of tar by the usual processes, it is possible to obtain a yield of about 18 per cent with practically no gaseous decomposition products. The product contains very little tar, and can be converted into montan wax and more or less low-boiling oils, from which a vaseline-like substance can be obtained as residue on fractional distillation.

Wyoming to Have Petroleum Lab

A research laboratory for testing crude petroleum and natural gas under the supervision of the United States Bureau of Mines, Department of the Interior, will be opened in connection with the University of Wyoming at Laramie on July 1. Several specialists will be assigned to this station and important research work on petroleum problems started at once.

The Direct Production of Iron

The First of Two Articles Comprising a Critical Review of the More Important Methods That Have Been Used to Produce Wrought Iron From the Ore

By Edvin Fornander
Chief Metallurgist, Sandvikens Jernverk, Sandviken, Sweden

AS IS well known, in early times wrought iron was always made direct from the ore, without going through the cast-iron stage. Up to about the sixteenth century this was the common method; the ore was reduced with charcoal in low shaft furnaces, in which the temperature was never high enough to cause any very considerable degree of carburization or melting of the liberated iron. From the modern viewpoint the process had many defects; the product was not uniform, the fuel consumption was very high, and even the amount of ore required was large, because much iron was lost in the slag. But even though the old direct methods had many and serious faults, their importance must not on that account be underestimated; they satisfied the iron requirements of mankind for a very long period of time—at least 3,000 years.

When the furnaces were enlarged and stronger blasts began to be used, there was formed in addition to the stiff melt of wrought iron a liquid non-malleable product, cast iron. At first the new product was not welcomed, but as soon as the discovery was made that the cast iron could be converted into wrought iron in a separate hearth, the advantage was seen of having the shaft furnaces produce cast iron exclusively—namely, that by making the process continuous the fuel consumption was lessened, and the loss of iron in the slag also became considerably less. Ever since that time—that is, for about 400 years—cast iron has been the raw material on which practically the entire iron industry has been based.

However great the present iron industry may be, due consideration must be given to those who say that making wrought iron by way of cast iron is a roundabout method, and that therefore any effort to devise direct methods, freed from the disadvantages of the early methods, is fully justified and worthy of attention. In so far as the trade in high-grade steel is concerned, it is evident that a relatively cheap low-carbon raw material, made from uncontaminated ore, would be highly welcome to supplement the supply of pure cast iron.

Especially during the '50s and '60s of the last century, many proposals for such a direct method of making iron were advanced. Thus, for example, in Germany alone no less than seventy-five patents were issued which were more or less devoted to this purpose.

In this paper a few of these direct methods will be discussed, taking into consideration chiefly those that are more interesting as being typical of their class. To describe a large number of processes would be unnecessary and would obscure the clarity of the picture it is desired to convey. Two types of processes can be distinguished:

(*a*) The reducing charcoal is placed in direct contact with the ore, more or less intimately mixed.

(*b*) The reduction is carried out with gas, in which carbon monoxide constitutes the principal reducing agent.

Before proceeding further, it would be well to recall the principal reactions involved in the reduction of iron ore and the equilibrium relations, especially between CO_2 and CO, which prevail at different temperatures. Fig. 1 shows the well-known curves; it should be noted, however, that the old Curve III of Baur and Glässner has been replaced by a new one published by Terres and Pongracz in 1919. Any more detailed explanation of the curves would be superfluous, since the whole subject is presented in metallurgical textbooks.

There is a large and growing group of American metallurgists who believe that it is possible to develop a method of producing wrought iron directly from the ore with a great increase in economy over the indirect methods now in use. The work that the United States Bureau of Mines is doing toward this end is indicative of the importance of the problem. The accompanying article by the foremost European authority is an important contribution to the literature on this subject, and while it holds little of interest to some of our readers it will be of real value to the workers in the field to which it applies

Chenot's Methods

The name of Adrien Chenot is coupled with two direct methods of making iron, both of which attracted considerable attention in their time; the inventor was awarded the gold medal at the World's Fair in Paris in 1855. In one of these methods, using lump charcoal, the principle consisted in charging ore and charcoal into an upright walled retort, around which ran channels in the masonry of the wall. Through these channels hot combustion gases were passed from separate fireplaces. Chenot had worked at perfecting his process ever since 1823 and by about 1850 it had progressed so far that the majority of factories had been using it on a rather large scale for a more or less long time.

J. W. Ramsay visited one of these factories (at Raumont in northern France) in the summer of 1859.

The account given below is taken mainly from the report of his trip. (See "Jernkontorets Annaler," 1860, p. 93.)

The ore was obtained from Sommorostro in Spain. It consisted of a mixture of ferric oxide and ferrous carbonate; after roasting, it contained 62 per cent of iron. The factory had two furnaces of Chenot's latest design. Each furnace had two rectangular reduction pipes, each having a horizontal cross-section of 2x0.50 meters. The total height of the furnace was 13 meters.

The ore was roasted, crushed to walnut size, and while being charged into the furnace was mixed with somewhat more than the calculated amount of charcoal required for reduction. The pipes were covered with a lid so that no gas could escape at their tops. The gases formed in the reduction were passed out through narrow iron pipes set at intervals in the walls, and used to light the factory. The reduction pipes were heated

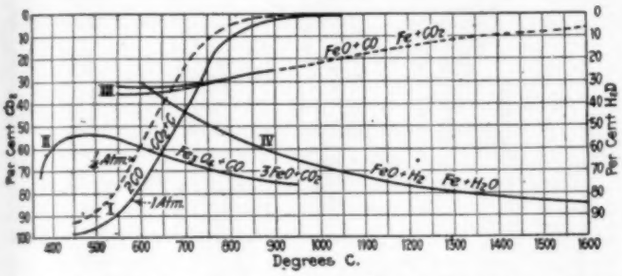


Fig. 1—Equilibrium Curves for Reactions in Reduction of Ore

by coal fires in six fireplaces, the flue gases being passed through the above-mentioned channels in the walls. The temperature in the reduction pipes is reported to have been "a strong red heat"—that is, probably about 800 deg. C. The heat escaping from these channels was used, among other purposes, for calcining the ore. After the ore had fallen down through the reduction pipes and had been changed into spongy iron, it passed to a cooler placed along the bottom. This cooler consisted of a sheet-iron tray with double walls, between which cold water was circulated. The spongy iron thus obtained was then freed from charcoal, ashes and foreign minerals.

This double furnace yielded 2.75 metric tons of spongy iron per day; the charcoal requirement was 370 kg. per ton. Coal consumption ran as high as 770 kg. per ton. No analyses of the spongy iron are given, but the high yield which is claimed with respect to the ore used seems to indicate that the "spongy iron" was not completely reduced. Reduction required 3 days and cooling the same length of time; hence the time taken by the furnace for each charge was 6 days.

From the Baracaldo foundry in Spain (where the Chenot method was also introduced) figures for the year 1862 are available (Percy-Wedding, *Eisenhüttenkunde*, 1864, vol. 2, No. 1, p. 589) as follows: Annual capacity, about 2,000 metric tons of spongy iron; powdered charcoal, 400 kg. per ton; coal, 1,100 kg. per ton; sponge per ton of melted charge (hearth scrap), 1,400 kg. The ore that was used came from Campanil, near Bilbao. Its iron content after roasting was about 67 per cent.

The other of Chenot's methods, which was characterized by the use of producer gas as reducing agent, also made use of a vertical reduction shaft, into which, however, only ore was charged. The gas for reduction was passed into the shaft from producers placed in the immediate vicinity. Charcoal was used as fuel in the producers. The carbon monoxide bearing gas that escaped from the top of the ore shaft was burned and utilized for drying the ore. Data for the year 1863 from the Laramade foundry in southern France are: Annual capacity, 600 metric tons of sponge; charcoal, per ton, 450 kg.; sponge per ton of melted charge, 2,000 kg. (See Percy-Wedding, *Eisenhüttenkunde*, 1864, vol. 2, No. 1, p. 589.) As will be shown below, the figure given for charcoal consumption is entirely too low, if it be assumed that the product obtained was in reality spongy iron. If, on the other hand, the figure is correct as given, the product from the reduction furnace must have consisted of only partly reduced ore instead of spongy iron. The high yield of "sponge" per ton of melted scrap also indicates that this was the case. The hardening process used seems to have been a sort of Catalan forging, and so the final reduction took place during this step in the process. Moreover, the ore in this case was not so rich as, for example, that used at Baracaldo; hence the "sponge" contained various minerals as impurities, which went into the slag in the hearth, and so increased the losses.

All the establishments that were built up for the utilization of the above-described Chenot methods failed sooner or later; they were apparently not able to compete with the indirect methods—that is, those that went by way of cast iron.

The Gurlt Method

In 1857, Adolf Gurlt, a German, proposed a method for making iron directly. (See *Eisenhüttenkunde*, vol. 2, No. 1, p. 596.) He pointed out that one of the disadvantages of the blast-furnace process lay in the fact that the ore and fuel were mixed under reducing conditions, so that the CO_2 which was formed reacted with the C which was also present, forming CO (see Fig. 1). Like others, the Gurlt reduction method made use of a shaft furnace (Fig. 2). The shaft *A* was

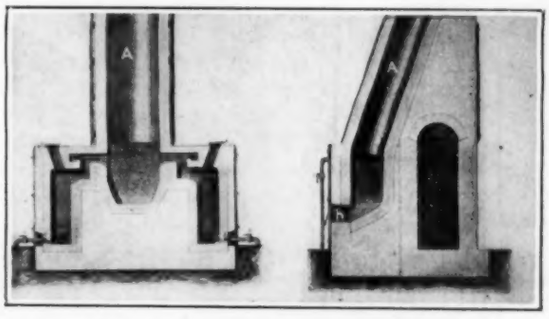


Fig. 2—Shaft Furnace Used by Gurlt

charged only with ore; reduction was carried out with gas from the producers *B*. In order to attain a sufficiently high temperature, a small part of the gas was burned, before passing into the reduction shaft, with air which was blown in through the channels *h*. This may be looked upon as a very doubtful expedient, since the reducing power of the gas was thus deliberately decreased. Moreover Gurlt, like Chenot in a similar case, seems not to have given sufficient consideration to the fact that the ore should to the greatest possible extent be uniformly heated to the proper reduction temperature so that the full reducing power of the gas could be made effective. This defect was remedied by later inventors, as will be seen shortly.

As may be seen, the Gurlt and Chenot gas reduction methods were identical in so far as their reduction procedure was concerned.

An experimental foundry was built near Bonn to work the Gurlt process. It consisted of a reduction furnace (11 meters high) and a reverberatory furnace in which the ore was to be sintered together or melted. Both red hematite and brown clay-bearing hematite were used as ore. The experiment was a complete failure. It is true that something was taken from the reduction furnace which was expected either to be or to contain spongy iron, but when this product was treated in the reverberatory furnace to separate the slag and obtain compact iron the final result was only a slag rich in iron. There were several causes for this unfortunate failure. The ores were dense, inclined to sinter and hard to reduce; moreover, they were poor, for which reason much iron was lost in the slag as fer

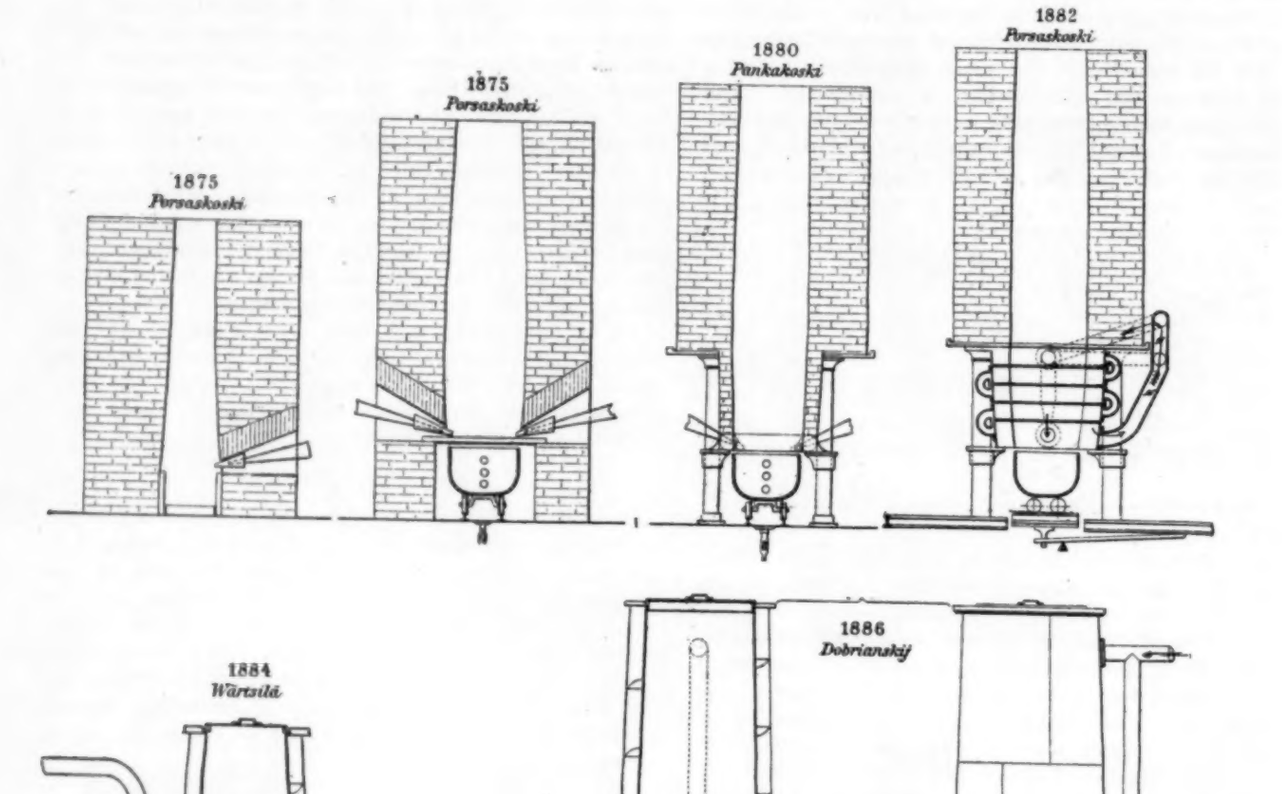


Fig. 3—Evolution of Husgafvel Furnace

rous silicate; and finally, the imperfect reverberatory furnace that was used tended to oxidize any iron which was present.

But even though the result of the Bonn experiment was completely negative, the method was tried under other conditions where the expectation of success was much greater. Near Bolueta, in Spain, a foundry was built to work up a very rich ore from Sommorostro, containing 70 per cent Fe on the dry basis.

Here the experiment turned out better; spongy iron was obtained (at least partly), which was transferred to a Catalan forge to be made into wrought iron. It is reported that the daily production was 2.3 metric tons of sponge, with a charcoal consumption of 400 kg. per ton. Each ton of bar iron required not less than 1.85 tons of sponge. The figure for fuel consumption leads to the same comments as those given above in the discussion of the Chenot gas reduction process at Laramade.

The Method of Husgafvel

Husgafvel has given a detailed description of his process in the "Jernkontorets Annalen" for 1887, from which the following account is taken. His method was a development of the old Finnish method of making wrought iron direct from lake or bog ore in a shaft furnace. Fig. 3 shows the gradual evolution of the Husgafvel process up to the furnaces built at Wärtsilä (Finland) and at the Dobrianskij iron foundry in Russia.

The inside height of the Dobrianskij furnace was 8.50 meters and its diameter at the widest part was 1.60 meters. It had double sheet-iron walls; the air current necessary for the process was forced in between these walls from above. During its spiral passage down to the lower part of the furnace the air cooled the walls and was itself heated. Only the lower part of the double sheet-iron jacket was lined with a thin layer of brick. There were two rows of blast holes, one above the other, and the blowers could be set in at more or less of an angle if necessary. When the current from the bellows was so directed as to come in close contact with the upper surface of the thoroughly reduced melt lying at the bottom, it had a refining effect in that the carbon content of the iron was decreased. The lower part of the furnace was made of large cast-iron plates. The furnace had two bottoms, which were made readily interchangeable by being entirely separate from the rest of the furnace and mounted on wheels. When a sufficient amount of pasty iron had collected in the one that was in use, it was removed and turned upside down to empty out the cohering melt.

The furnace was charged with charcoal and ore exactly as a blast furnace is charged, and the reduction process took place in the same way, excepting that the temperature was lower owing to the cooling action of the walls and the higher charge of ore. The iron did not carburize to any great extent, and the iron that collected at the bottom was malleable. The following means for regulating the carbon content were available: Size of ore charge, blast temperature, position and direction of the blast. The Dobrianskij iron was made into ingots, which in turn were rolled into sheets. Operating data for this furnace are given below:

A magnetic iron ore containing 58 per cent Fe, mixed with charcoal (58 per cent birch and 42 per cent pine) gave: Maximum daily production of iron, 3,100 kg.; minimum charcoal consumption (per ton of iron), 1,360 kg.; maximum yield of iron from ore, 52.7 per cent.

When soft iron was made, the loss in the slag was greater than when iron with a higher carbon content was being produced, which of course was quite natural. Slag from the manufacture of hard but still malleable steel (carbon content not stated) contained 7.2 per cent Fe, whereas the slag from iron contained 40.8 per cent Fe. According to Dobrianskij data the iron losses in the slag were 9 per cent for steel and 17 per cent for iron.

The reported charcoal consumption seems high compared with modern practice in making cast iron; but it must be borne in mind that these figures refer to a very small furnace, only 8.5 meters high. It is probable that the charcoal requirement can be materially reduced by using a larger furnace; and it is also possible that the black Russian ore used in this case was unusually hard to reduce and that the charcoal consumption would have been considerably lessened by charging partly with briquetted or sintered hematite. The report does not state the temperature of the blast nor give any analyses of the iron or of the effluent gas.

Besides the Wärtsilä and Dobrianskij trials, a Husgafvel furnace was built at the Poutiloff foundry in St. Petersburg. According to the statement of a person who saw this furnace, it was 12 or 13 meters high and 1.5 to 1.7 meters in diameter at the widest part. About 1890 this furnace was still in operation, but it is said to have blown down not long after that.

Wiborgh's Method

At the 1899 Iron Founders' Congress Professor Wiborgh proposed his method for direct production of iron, designed for working up rich ores. The object was to make spongy iron, which was then to be melted down in a Martin furnace.

The process was intended to be carried out in a reverberatory furnace of the forward motion type. The chief reducing agent was powdered charcoal, in addition to which producer gas was used to help heat the furnace, and in some cases even for reduction.

So far as can be ascertained, the Wiborgh reduction furnace never came into practical use. A serious defect of his method was that it required a great deal of labor. Among the advantages may be mentioned the fact that the heat from the fuel seems to have been very well utilized, and that the process was easy to control and regulate; for these reasons it might deserve consideration when it is required only to cover a minimum requirement of a pure product.

The Gröndal Process

In 1909 Gröndal tried out at Herräng a method he had devised for making spongy iron. (See "Jernkontorets Annalen," 1912, p. 158.) The principle employed was as follows: Rich slimes, together with the amount of powdered charcoal required for reduction, were fed into the upper end of a long inclined rotary furnace. The gas formed in the reduction was withdrawn at the upper end of the furnace and pumped into a brick regenerator, where it was heated to 800 to 1,000 deg., after which the gas was again passed into the furnace at the lower end. During its passage through the furnace the circulating gas gave up the heat it had

absorbed in the regenerator. There were two regenerators and while one was heating the gas the other was being heated. This heat was obtained by combustion of the gas produced by reduction, together with producer gas from an outside source. It thus appears that Gröndal applied the same basic principle as Wiborgh, but used a rotary furnace, whereas Wiborgh proposed a forward motion furnace with a hearth. Gröndal calculated his fuel consumption per ton of sponge to be: Coal to heat circulating gas, 0.6 to 0.8 ton; charcoal for reduction, 0.22 ton. The published account of the experiment is none too comprehensive; it mentions three short experimental periods. All told, a few tons of spongy iron were obtained. No figures are given for the actually observed fuel consumption.

The furnace arrangement just described had the disadvantage of being very complicated; for example, the introduction of regenerators, which had to be connected alternately, made necessary a number of valves, some of which had to function at temperatures as high as 1,000 deg. C.

The Sieurin Method

The Sieurin method of making spongy iron was especially devised to increase the usefulness of one of the poorer varieties of coal such as are taken from the Höganäs Co.'s Schonen mines in southern Sweden. The basic principle of the method was the same as that of the Wiborgh and Gröndal methods described above. The reduction itself was carried out with charcoal, and the extra heat supply necessary for the process was obtained by burning producer gas. The method began to be used on a large scale at Höganäs in 1911; the description given below is taken partly from Sieurin's report to the 1911 Iron Founders' Congress (see "Jernkontorets Annalen," 1911, p. 448) and partly from recent statements of the inventor himself.

The slimes and powdered coal, lying in alternate layers, were heated in a closed round brick chamber till the reduction was complete; after the charge had cooled it was taken from the chamber and mechanically separated from the residue of the reducing agent. The process was carried out in large gas-fired Mendheim ring furnaces on the same system as that used in potteries. The reducing agent was Höganäs coal No. 2, containing 35 per cent ash and having a fuel value of about 4,000 units.

A schematic view of the furnace is shown in Fig. 4. The different parts are: (1) charging, (2) discharging, (3) preheater, (4) combustion and (5) cooling. The pasteboard damper (*b*) prevents air from the charging portion from getting into the furnace, and the smoke is forced to pass through the draft (7), in which the smoke damper is open, and so into the chimney.

The combustion takes place in the following way: The air comes in through the discharging portion, cools the combustion chamber and is itself correspondingly heated, till finally in the combustion region it encounters gas, partly from the combustion and partly from pipes leading in from separate producers. The combustion gases, containing an excess of air, pass on further and heat the chamber in the charging region, during which time more and more of the oxygen is consumed by the tar vapors coming from the combustion chamber. Finally the gas, at a temperature of 150 to 200 deg., goes into the chimney. In accordance with the principle of the ring furnace, the latent heat of the burned material is thus used to preheat the air for combustion, and the combustion gas is made to preheat the material that is to be burned.

The most troublesome part of the process is the sulphur problem. The Schonen coals contain 0.5 to 1.0 per cent of sulphur, and unless this is otherwise absorbed the iron obtained may contain 0.4 to 0.8 per cent of sulphur. By adding lime to the coal the sulphur is almost completely prevented from contaminating the iron.

The ore used at Höganäs consisted of slimes made from Gellivare ore; it contained about 71 per cent of Fe, 0.010 per cent of P and 0.002 per cent of S. The sponge contained about 94 per cent Fe, 0.010 to 0.015 per cent P and 0.010 to 0.030 per cent S.

Operation at Höganäs required: Slimes, 1,420 kg. per ton of sponge; charging coal, 1,050 kg. per ton of sponge (of this 1,050 kg. the actual reduction coal amounted to about 690 kg. and the rest (about 360 kg.)

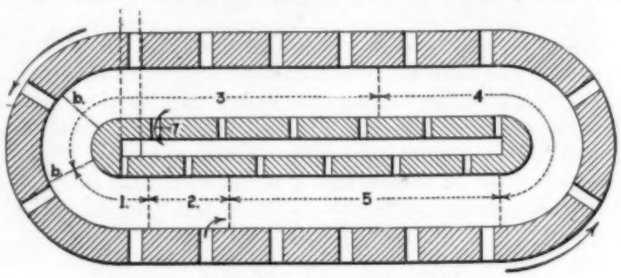


Fig. 4—Schematic View of Sieurin Furnace

was so-called protection coal—that is, it was intended to protect the reduced sponge from re-oxidation); lime, 190 kg. per ton; saggers, 3 or 4 per ton.

For a projected foundry in another place, where it was planned to use a coal with 22 per cent ash, the following figures were calculated: Reduction and protection coal, 800 kg. per ton; coal for producers, 270 kg. per ton; a total of 1,070 kg. per ton. So far as is known this is the only method of making spongy iron which has been in practical use in recent years; from 1913 to 1919 the Höganäs foundry produced altogether about 50,000 tons of sponge. This was mostly used for making high-grade steel in Martin or electric furnaces. The product thus obtained was found to be very good. The sponge is not easily combustible and the burning loss in the Martin furnaces was not too greatly increased by the addition of sponge to the charge.

One of the difficulties of the process is the use of brick saggers. This is a large item of consumption, and hence, although the process had good prospects of success at Höganäs in connection with the clay-burning industry, the conditions would be different and might even be reversed in another plant—for example, in central Sweden.

Besides the Höganäs plant with an annual capacity of 12,000 tons, there is a plant in Japan with a capacity of 20,000 tons.

The ring furnace construction used for this process seems, from a certain viewpoint, to be well adapted for the purpose, but on the other hand attention may be called to the high consumption of so-called protection coal, for which the blame may be placed on the type of furnace used, because the saggers are cooled in air and not in an inert atmosphere.

Status of the Dye Industry in Great Britain

Some Economic Factors Responsible for Its Development and Present Tendencies

By Frederick E. Breithut
American Trade Commissioner, Department of Commerce

IF ALL of the dyestuff factories of Great Britain were fully employed, it is estimated that they could produce more than 40,000 tons of dyestuffs per annum. As the total importation of dyestuffs during 1913 amounted to about 18,000 tons and the total domestic production in that year was about 4,500 tons, it is apparent that Great Britain's capacity for dye production is far in excess of the needs of home consumers. It is also evident that if British dye manufacturers are to keep their plants going at full capacity, it is necessary for them to increase their export trade. The dyestuffs situation in Great Britain, from the standpoint of production capacity, is thus quite similar to the situation in the United States.

It has been claimed that Great Britain was producing 20 per cent of her consuming requirements in 1913; hence, from a study of 1913 importations, which were approximately 32,000,000 lb., it is evident that the British production during that year amounted to about 9,000,000 lb. and the consumption to approximately 41,000,000 lb. Assuming the textile industry to be the major consumer and guided by the consensus of the trade journals, it has been estimated that the English consumption of dyes in 1922 was approximately 65 per cent of that of 1913. On this basis, the consumption in the latter year would have been approximately 27,000,000 lb. It has been further estimated that Great Britain is catering to approximately 80 per cent of her present domestic requirements, which on the basis of the foregoing as well as the recorded importation of about 5,000,000 lb., would show a production of approximately 21,000,000 lb. for the year 1922. This, in brief, indicates that in 1922 Great Britain had more than doubled its production of 1913. However, the present production would be adequate for less than half of the country's consuming demand in the year 1913.

Progress in Producing Vat Dyes

Considering the fact that Great Britain has always been a world factor in the production of chrome and alizarine colors, it may be safely assumed that approximately 50 per cent of the production in 1913 was made up of these colors, and that the remainder, in view of their comparative simplicity of manufacture and a major consuming demand, was made up of sulphur, direct, acid and basic colors in the ratio of 20, 20, 7 and 3 per cent, respectively. However, many of these colors were manufactured from intermediates obtained from Germany. This was particularly the case in indigo, which was being manufactured from the advanced intermediate products obtained from that source. The same was true of oil, spirit and wax colors, the demand for which was comparatively limited.

A striking example of the progress made since 1913 is found in the case of the vat dyes, a group which includes synthetic indigo and the modern vat colors discovered on the Continent since the beginning of the present century. In 1923 the British production of these extremely valuable dyes (excluding indigo) was nil, while in 1922 it exceeded 82 tons, being about 40 per cent of the total home consumption of these coloring matters. This improvement redounds to the credit of the chemists and engineers concerned, for it consists not merely in working out complicated syntheses in the laboratory but in designing entirely new plant for the carrying out of difficult and dangerous operations on a manufacturing scale.

Great Britain's dye industry is in much better condition than is generally understood. Eighty per cent of the English consumption is now supplied by domestic production, as compared with 20 per cent before the war. When it is considered that a large part of the latter output was the mere coupling together of intermediates "made in Germany," it is evident that the industry has had a remarkable growth.

Major Breithut ably discusses this progress in a recent government bulletin, issued as one of a series based on field investigations in several European countries.

These mechanical appliances include large size autoclaves capable of withstanding high pressures, ammonia-recovery plant, and special filtration apparatus adapted for the collection of the costly chemical products. The Krupp autoclave has now been replaced by well-designed British types, and a battery of the latter appliances which has recently been installed at the Grangemouth section of Scottish Dyes (Ltd.) possesses all the latest devices for efficient working and regulation, coupled with adequate safeguards for the workers who control these high-pressure operations.

Factors Affecting Future of Industry

The principal points in favor of the future development of the British dyestuffs industry are the following:

1. The possession of adequate supplies of raw materials. The output of benzol and its homologues, naphthalene, anthracene, etc., by the byproduct coke ovens and gas works is not only sufficient for the needs of the dye industry but permits a large export of these commodities. Of the accessory raw materials, such as sulphuric acid, soda ash and the like, England has ample capacity for production also. The dependence of the country on Chilean saltpeter for the manufacture of nitric acid is being overcome by the synthetic-ammonia plant of the Brunner-Mond Co. at Billingham. This plant has a contact nitric-acid plant which will enable the British to make nitric acid from the air instead of depending on Chile for nitrate.

2. The possession of excellently trained chemists and chemical engineers who have long proved their ability to do research and development of the highest order. In the last few years the British technical men have amply demonstrated their capacity to translate purely scientific results into the equally difficult problem of plant production.

Extracts from Trade Information Bulletin 231, just issued by the Chemical Division of the Bureau of Foreign and Domestic Commerce.

3. The realization by the scientific men of the country of the national importance of the industry, and their insistence on its continuance are also assets of importance.

On the other hand, the principal drawbacks to the full development of a self-sufficient and self-sustained British dye industry are:

DRAWBACKS TO FULL DEVELOPMENT

1. The proposed merger of the interests of the British Dyestuffs Corporation (estimated to control 40 per cent of total British production) and the Interessen Gemeinschaft.

2. The state in which the British Dyestuffs Corporation finds itself as a result of its failure to fulfill the high hopes which were entertained for it when the corporation was first established.

3. The strength of the German competition. The pre-war habit of consumers of using German dyes and relying on the services of the German manufacturers in the dyehouse is difficult to change. Fear of German competition is strong. If the protection of the present dyestuffs act were removed, there can be no doubt that the British dye industry would find itself in great difficulties.

4. The British spirit of individualism in commerce which expresses itself in its traditional policy of free trade and its abhorrence of nurturing industries through government protection. There is little hope of extending the present dyestuffs act when it has run its course of seven more years. Its repeal is possible at any time, and this constitutes a menace that is constantly before British dye manufacturers. The curtailment of their development program is a natural result.

5. England's lack of appreciation of her scientific men. The establishment and maintenance of a dye industry is not to be brought about by lawyers, politicians, statesmen and financiers. The direction of so highly complicated and technical an industry by men unacquainted with its real problems is doomed to failure before it begins. The usual methods of business are wholly inapplicable to this particular industry. Its highly complicated technical nature requires the presence of technical men on the directorate as well as in the plant. Germany owes part of its great success in this industry to a recognition of this fact, and both England and the United States could profitably capitalize Germany's experience.

PROBLEM REQUIRES TIME TO SOLVE

Time is the essence of the problem in both England and America. Time is required for research; time is required for development; time is required to translate the results of research and development into factory production; time is needed for organization of the industry; and time is needed to enable the manufacturers to study the consumers' requirements so as to be in a position to render them a service equivalent to that which the German industry gave before the war.

During this period of development the British textile industry and the many others dependent on dyes will have to be willing to pay somewhat higher prices for the sake of having their own dye industry.

In a word, England has every reason to want her own dye industry. She already has a large part of it well established. She can have it as a permanent asset if she will, but she must be willing to pay the price.

Importance of Scientific Research In the Cellulose Industry

Attention may be called to the fact that many apparently insignificant observations and discoveries have had epoch-making significance in industrial progress; and an effort will be made to show what the contribution of scientific research is to this progress, says Heuser in *Chemiker-Zeitung*, vol. 48, p. 252 (April 22, 1924). As examples the experiments and discoveries of Brandt on the alkaline process of making pulp may be cited; also Tilghman's chance discovery; and the contributions of Ekman and Mitscherlich to the development of the sulphite process.

The importance of scientific research is particularly noticeable in connection with attempts to utilize waste sulphite liquors. The most important problem arising from the sulphite liquor investigation is the lignin problem. In this connection may be mentioned the investigations of the past year on lignin, including the researches of Hoenig and his co-workers, and of Heuser, Winsvold and Herrman, Willstaetter and Kalb, Karrer, E. Schmidt, Haegglund, and of Schrauth.

The pulping of cellulose, bleaching, sizing and other operations are examples of the epoch-making character of the discoveries made; and they illustrate the influence of the research laboratory on the growth of the industries concerned. In this connection may be mentioned the latest results—for example, the Schwalbe theory of bleaching, the experiments of Heuser and Niethammer, on the use of liquid chlorine for bleaching, Heuser's colloid-chemical theory of sizing, and the work of Stockigt, of Klingener, of Lorenz and of Sieber.

Even though its technical development may be considered almost complete, there is still much uncertainty about the scientific explanation. In particular there is still dispute about whether or not cellulose takes up soda in stoichiometric relations. In this connection Heuser and Niethammer showed that the amount taken up by the cellulose increases with increasing alkali concentration. Rassow and Wadewitz have recently come to the same conclusion. Accordingly it appears that alkali cellulose is an adsorption compound. Finally, the artificial silk industry furnishes many examples of the importance of research. In this connection the depolymerization of cellulose may be cited as a problem the solution of which is of great importance to the artificial silk industry.

Requirements for Nickel Anodes

Nickel anodes, such as are used for replenishing the solution in nickel plating, have formed the subject of a recent investigation at the Bureau of Standards. The purpose was to determine the relative behavior of different forms of nickel, such as electrolytic, rolled and cast nickel, in the solutions used for electroplating. A study was also made of the effect of impurities.

The experiments showed that the addition of a chloride to the solution caused all types of anodes to dissolve with high efficiency. The chief difference in the behavior of the different types of anodes was in the uniformity with which they dissolved.

Anodes having a relatively high carbon content were found to dissolve more readily than do the more nearly pure forms of nickel, about 1.5 per cent of carbon being found satisfactory. Appreciable amounts of sulphur and copper were found to have a harmful effect.

Californian Whale Oil Industry

Although the whale is not a fish, whale oil is generally classed as a fish oil. The center of the industry in the United States has shifted in recent years from the east to the west coast, where it started at a comparatively recent date—about the time of the California gold rush. The introduction of steam whaling vessels in 1880 was followed by the building of a sperm-oil refinery in San Francisco in 1883 and the manufacture of candles, an industry that has since declined materially. The following account outlines present-day methods of capture and recovery of the oil from the whales now found in Californian waters.

THE Californian whaling industry depends mainly on the capture of the humpback, so called because of its personal appearance. It is usually about 50 ft. long. A few finbacks are occasionally encountered, but this species is more numerous in the vicinity of the whaling stations of the Falkland Islands, far to the south. The finback averages in length more than does the humpback, sometimes reaching 80 ft. Rarer species met with in Californian waters include the bottlenose, a small variety, which yields an oil similar to sperm oil.

Modern whale fishing may be said to owe its inception to Henry Hudson, about 1607, whose voyages to Greenland and Spitzbergen supplied the incentive for a new type of commercialized adventure. Between the middle of the seventeenth century and the end of the eighteenth century the yields were tremendous. Followed a decline until the invention of the harpoon gun and the utilization of the meat for fertilizer purposes, about the middle of the nineteenth century. Although whale oil was used formerly almost entirely as an illuminant, the

Whale-Oil Plant at Moss Landing, California

process of hydrogenation has made its application possible for the manufacture of lard substitutes, soap and candles; for the treatment of leather and jute; as a medium for use in steel-tempering baths, as a lubricant and for the manufacture of watertight roofing composition.

Early exploitation involved unpardonable waste. Some whales were killed mainly for the blubber, others for the so-called bone found in the mouth and used in immense quantity for that armored garment, the corset, Today, however, nothing is wasted. The oil is recovered and the meat and bones are dried and sold as fertilizer. The meat is high in fat-soluble vitamins and is being used as a food product in some countries.

The result of intensive fishing has been the denuding of the whaling grounds, and in consequence the equipment lies idle for many months in the year. Large whaling stations are necessary. A day's catch may aggregate 150 tons or more, and prompt treatment of the dead carcass is, as may be imagined, essential. The California Sea Products Co., Captain F. K. Dedrick, president, maintains two stations in California, one at Moss Landing, in Monterey County, and the other at Trinidad Harbor, in Humboldt County. In place of the historical whale boat, a fleet of small steamers is engaged in the capture of the raw product. The animal's warm breath, which condenses in the cooler atmosphere, is mistaken by the uninitiated for a spout of water. Anyway, it gives a signal of loaction, and thither goes the ship at full speed. At the next appearance to breathe, the operator of the gun sights the quarry and sends the harpoon to do its work. A bomb explodes on contact; four claws serve as barbs. If the shot has been a lucky one, the animal dies immediately, and is drawn toward the ship by winch purchase of the rope attached to the harpoon. Compressed air is then delivered through a perforated pipe, which is driven into the belly, to provide sufficient buoyancy to enable

Landing Platform and Oil-Expressing Vats

the whale to float until the catch is collected later in the day and towed to the station. If the whale is not killed by the first shot from the harpoon gun, the operations are much more extended, and the personal element is brought into strong relief, especially when the final killing is done by hand at close quarters.

At the station the whale is hauled by winch to a platform, where men and machinery dissect meat from blubber. The latter is first sliced by machine and given a preliminary cooking in open vats fitted with steam coils, containing about 20 tons apiece. The meat, in large pieces, goes to steam boilers operated under a pressure of 60 lb., each with a capacity of about 15 tons. Large digesters, holding about 30 tons apiece, are used to cook the bones.

The oil from the various steam kettles and cookers goes to cooling tanks, from which it is decanted to storage and shipped in tank cars; four types of oil are produced, differing mainly because of free fatty acid content. The residue is drained of excess water, cut, and passed through an oil-fired rotary drier, the product being used for fertilizer purposes. The bones are dried, ground and shipped to the Hawaiian Islands, to be used as fertilizer in the sugar and pineapple planations.

Canada's Non-Ferrous Industry Grows

More than $100,000,000 was invested in plants in Canada manufacturing products from metals other than iron and steel in 1922, and the value of the production was $70,855,693, according to figures compiled by the Dominion Bureau of Statistics. Compared with the preceding year the production was 2.5 per cent less.

Heat Transfer vs. Agitation

A Discussion of the Use of Agitation as a Means of Increase of Heating or Cooling in Places Where It Is Difficult to Provide More Transfer Surface

By David E. Pierce and Philip B. Terry
Jackson Laboratory, E. I. du Pont de Nemours & Co.

THE chemical engineer is frequently confronted with the problem of increasing the rate of cooling or heating in a tub or reaction vessel in which heat transfer surface is provided by iron, lead or copper coils. Since it is often difficult or impossible to add more coils to the equipment available, it is therefore of prime importance to secure maximum efficiency from the apparatus already provided. In such instances an analysis of the several thermal resistances interposed between charge and cooling water or brine will be of great value in deciding which factor offers the greatest opportunity for improvement.

It will be evident that R, the overall resistance to the transfer of heat from hot solution to cooling water, is the sum of a series of three individual resistances: r_L, the resistance of the film of liquid clinging to the outer surfaces of the pipe; r_p, the resistance of the metal of the pipe itself, and r_w, the resistance of the water film on the inside of the pipe. Evidently, for a given installation, nothing can be done to change r_p, the resistance of the metal pipe, so that any improvements must be confined to the decreasing of r_L and of r_w.

So far as calculating the resistance on the inner surface of the pipe is concerned, there is considerable information available. By referring to the work of McAdams and Frost (*Ind. Eng. Chem.*, 1922, vol. 14, p. 12), we find that the resistance of the water film per square foot of surface is given by the expression, $r_w = \frac{D^{0.394}}{199u^{0.786}J^{0.786}}$, where D is the inside diameter of the pipe in inches, u is the water velocity in feet per second and J is the average fluidity of the cooling water—that is, the reciprocal of the viscosity. Considering this formula, one sees that, for a coil already in use, no change is desired in D, nor would there be much possibility of controlling the fluidity of the cooling water. There remains, then, as a variable factor only the water velocity, and therefore by using the formula to which reference has been made above, the effect of increased velocity upon r_w can be readily calculated, remembering that $r_w = \frac{1}{h_w A_w}$, where h_w is the surface coefficient of heat transfer on the water side and A_w is the area in square feet of that surface.

For the remaining resistance, r_L (through the liquid film on the outside surface of the coil) very little information has been published. Hausbrand has given certain empirical equations for calculating the effect of velocity upon the coefficient of heat transfer and Royds ("Heat Transmission by Radiation, Conduction and Convection," Constable & Co., 1921, pp. 214-220) describes some experiments by Austin upon the effect of stirring and of natural convection upon the resistance to heat flow of a metal wall in contact with warm and with boiling water. However, neither of these sources is of great value in the handling of the specific problem of this paper. There remains, then, no way of predicting the effect of changes in conditions upon r_L other than by analogy from the relations that have been found to hold good for fluids in pipes, as previously noted.

Since it seems obvious that the factors which would be of controlling importance are the arrangement of the coils in relation to the agitator, the type of the agitator and its speed, there appears to be need for the study of each of these items. Naturally, for a given installation, the simplest change that can be made is to increase the speed of agitation. The publication of data upon the effect of such speed variations should be of considerable interest and value to chemical engineers who may be confronted with problems of this sort, and it is to be hoped that more information will be made available by other experimenters.

From tests carried out at this laboratory, data have been obtained to show the effect of agitator speeds upon heat transfer coefficients and therefore upon thermal resistances in the cooling of warm water in a 300-gal. wooden tub by means of water passing through a ¾-in. lead coil. Table I presents the essential data and Table II the values calculated therefrom. Figs. 1, 2 and 3 show graphically some of the interesting results.

HEAT TRANSFER

It is well known that heat transfer from one liquid through a wall to another liquid increases with the relative velocity of flow of the two liquids. This is because the increased velocity lessens the resistance of the films on each side of the wall to the passage of heat. In the accompanying paper the authors present the case for increased velocity against increased transfer surface when the necessity arises for increasing heat transfer.

A UNIT PROCESS OF CHEMICAL ENGINEERING

Table I

Run No.	Time in Min.	Agitator R.p.m.	Agitator Peripheral Speed in Ft./Sec.	Charge in Tub Initial Temp. °F.	Charge in Tub Final Temp. °F.	Cooling Water Velocity Through Coil in Ft./Sec.	Cooling Water Average Temp. °F.	Cooling Water Average Rise in Temp. °F. Through Coil	Average Temp. Diff. in °F. Between Charge and Cooling Water
I	10	0	0.0	176	152	9.23	82.0	44.2	80.0
II	16	14	2.4	175	118	9.13	95.9	70.0	42.3
III	10	25	4.3	172	129	9.23	98.6	77.2	38.4
IV	16	27	4.7	175	115	9.23	93.2	75.8	39.3
V	14	40	6.9	176	119	9.57	99.1	75.8	35.5

Tub used: 300 gal., 4 ft. diam. x 3 ft. deep, wood staves.
Agitator blade: 39.5 in. long.
Coil: 121 ft. of ¾-in. extra heavy lead pipe, wrapped around the side of the tub.
Charge: Water, heated up by steam to initial temperature shown in table. Total weight, 2,120 lb.

Table II

Run No.	Agitator R.p.m.	Thermal resistances per sq.ft. of external coil area, expressed as 1,000 × Ave. Δ t / B.t.u. Transferred — Resistance of — Total R ($= \Sigma r$)	Inner Surface r_w	Metal Wall r_p	Outer Surface r_L	Heat transfer coefficients for each surface, expressed as B.t.u. per hour per sq.ft. per deg. F. difference — Over-all H	Inner Surface h_w	Metal Wall $\frac{k}{l}$	Outer Surface h_L
I	0	11.3	1.3	1.3	8.7	90	1,300	1,000	110
II	14	3.8	1.1	1.3	1.4	260	1,500	1,000	700
III	25	3.1	1.1	1.3	0.7	320	1,500	1,000	1,400
IV	27	3.2	1.1	1.3	0.8	310	1,500	1,000	1,300
V	40	2.8	1.0	1.3	0.5	360	1,600	1,000	2,000

In the first two figures, heat transfer coefficients (over-all and external surface respectively) have been plotted against agitator speed. These coefficients are those commonly employed in heat transfer work, using equations of the form $Q = HA\Delta t$ for over-all transfer, and

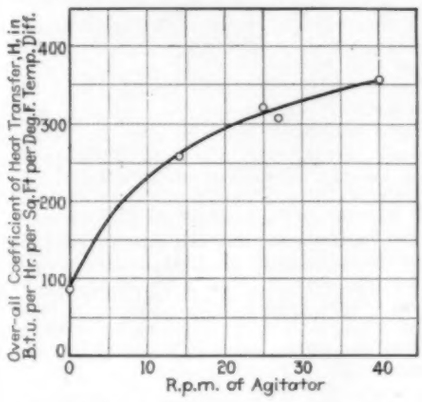


Fig. 1—Effect of Agitator Speed on Over-All Heat Transfer Coefficient *H*

$Q = hA\Delta t$ for flow through a single surface film. Expressing Q as B.t.u. per hour, A as square feet and Δt as deg. F. temperature difference, it will be evident that the coefficients H and h are in terms of B.t.u. per hour per sq.ft. per deg. F. From the first of these figures, it will be observed that the over-all coefficient H shows continual improvement as the speed of agitation increases. However, the curve is flattening out so that further speeding up of the agitation would not produce a proportionate increase in the value of H. On the other hand, from the points plotted for the external surface coefficient, h_L, it would appear that this curve had not approached any point of inflection, a straight line being the best curve possible for the points in question.

While a consideration of the two figures mentioned above is interesting, it is believed that Fig. 3 offers a better means of studying the effect of changing agitator speeds. Here, it will be noted, resistances have been plotted against the r.p.m. of the agitator, using the equation $R = \frac{\Delta t}{Q}$ for a definite length of pipe—namely, that amount having an external area of 1 sq.ft. The values of R, thus obtained, multiplied by 1,000, are therefore expressed as the number of deg. F. temperature difference required to transmit 1,000 B.t.u. per hour through the boundaries in question—that is, hot charge to cooling water. In like manner we may calculate r_p, the resistance through the metal ($= \frac{l}{kA}$, where l = thickness in feet, k = specific conductivity and A is average area) and r_w ($= \frac{1}{h_w A_w}$, where h_w is the heat transfer coefficient from Fig. 2 and A_w is the inner surface in contact with water). By difference, r_L is obtained and plotted, each of these individual resistances, like the over-all resistance, being multiplied by 1,000.

Fig. 3, therefore, shows the relative importance of the three resistances at the boundaries, and also their magnitudes for the transmission of 1,000 B.t.u. per hour. Thus it is seen that when the charge was not agitated, except by the natural convection currents, the total resistance was 11.3 deg. F. per 1,000

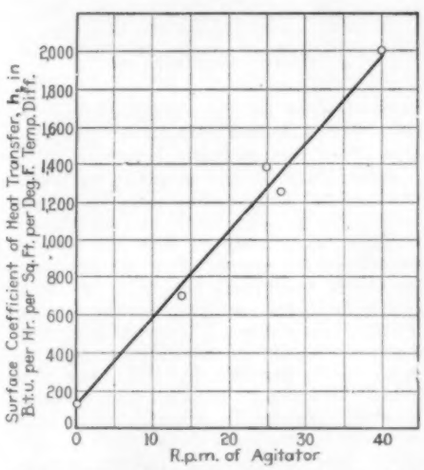


Fig. 2—Effect of Agitator Speed on Surface Heat Transfer Coefficient h_L

B.t.u., and that 77 per cent of this value was accounted for as r_L—that is, resistance in the film on the outside of the coils. At 14 r.p.m. the value of r_p (through the metal) was of course, unchanged, and that of r_w was likewise practically the same as it had been in the previous run, a slight variation being due to change in water pressure. On the other hand, r_L is seen to be very much less than before; in fact it now represents only 37 per cent of the total value of R. Further increases in agitator speed to 25 r.p.m. and then to 40 r.p.m. decreased r_L to 0.8 deg. F. and 0.5 deg. F. respectively, corresponding in the former case to 25 per cent and in the latter case to 18 per cent of the total over-all resistance.

To make a direct application of the data obtained in these tests, it would be desirable to know how the power consumption varied with the speed of agitation. Unfortunately, it was not possible to obtain power data. However, an interesting study of agitation efficiency reported by Wood, Whittemore & Badger (*Chem. & Met.*, 1923, vol. 27, p. 1178), for a 600-gal. tub (twice the size of our test tub) gave a power consumption of 7 watts at 16 r.p.m., 23 watts at 20 r.p.m. and 65 watts at 23 r.p.m. Further, the statement was made by these authors that efficient stirring took place at any speeds above 22 r.p.m. In the case of a tub of the size used in our experiments, it is of interest to observe that the three resistances are of approximately equal magnitude at about 15 to 20 r.p.m. and increased r.p.m. would decrease the over-all resistance very slightly beyond that region.

Further comments on the figures could be made from the standpoint of the application of this type of analysis to numerous other pieces of equipment. For example, nitrators are frequently controlled by means of coils, using brine or cooling water as the cooling medium. In case the nitrator is the "neck of the bottle" for rate of production, a study of the thermal resistances would readily show whether an increased rate of cooling could be more effectively attained by increasing the agitator speed, changing the type of agitator, pumping the cooling fluid at a higher speed or making changes in the size, position or material of the coils. Evidently, economy would be furthered by a wise use of such an analysis together with whatever actual tests could be performed.

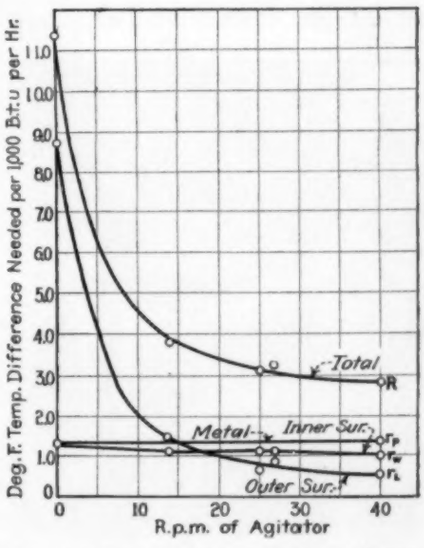


Fig. 3—Comparison of Thermal Resistances
The resistances of the two surface films temperature difference needed to transfer and the metal are expressed as the deg. F. 1,000 B.t.u. per hour, based on 1 sq.ft. of external surface.

Equipment News

From Maker and User

Process for Producing Uniform Firebrick

Such is the importance of uniformity in the size of firebrick that manufacturers of refractories have striven constantly to produce firebrick that are uniform in dimension as well as composition. Many have claimed that their brick was of uniform dimension, and for some time the Refractories Manufacturers Association has insisted that the variation of brick produced by its members did not exceed 3 per cent. It is only recently, however, that definite mechanical steps have been taken to secure that important result. Our readers will be interested in the details of a new device, developed by the Ashland Fire Brick Co., of Ashland, Ky., that trims the brick after they have been shaped and put through a pressing operation.

This new process for securing the uniformity that is so essential in prolonging the service of refractories includes the addition of a standard repressing while the brick itself undergoes two extra trimming and repressing operations in order to eliminate the variation present with the most improved types of brick machinery heretofore designed and built by the machinery manufacturers.

Brick manufactured by the new method in use at Ashland pass under a rotary cutter equipped with four knives operating at approximately 4,000 r.p.m. after they are taken from the repress, which formerly completed the manufacturing process up to the point of putting the brick on the tunnel cars for drying. The cutter is so constructed that it can be adjusted to take care of wear on the blades and to secure the desired thickness of the various brick being manufactured.

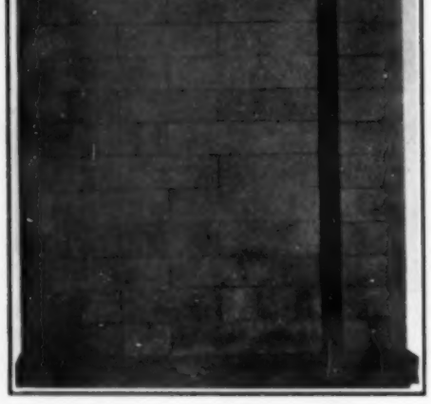


Fig. 1

Side and end view of piles of 13½x6x3-in. straight Ashland steam-pressed firebrick. The bubble in the center of the level shows how uniform the size is.

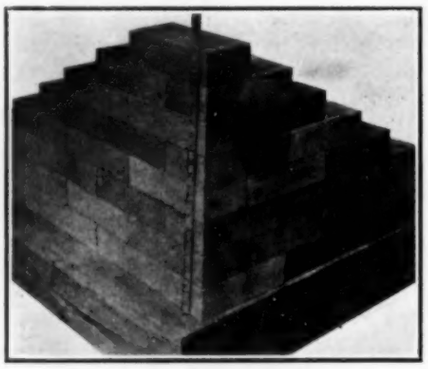


Fig. 2

Pile of standard 9x4½x2½-in. straight Ashland crown steam-pressed firebrick. Notice the eight rows of 2½-in. thickness each come to exactly 20 in.

Regardless of any original variation of thickness before they pass under the rotary cutter, the brick are absolutely uniform when they go into the second, or refinishing press. For all practical purposes, therefore, the brick is absolutely uniform, as the accompanying illustrations show. The great improvement in the art of manufacturing firebrick made possible by this new patented trimming device and double pressing results in a brick that lays up better, requires less mortar and offers less chance for failure at the joints—always the most vulnerable part of a lining.

High-Temperature Insulation

The temperatures encountered in chemical engineering work have constantly increased. Because of this, a more careful consideration of means of preventing heat losses from pipe lines and apparatus has become necessary. The materials ordinarily used for heat insulation have a limit beyond which they become inefficient. Particularly hot surfaces demand special insulating materials in order that the losses of heat may not be too high, and much attention is now being given to the solution of this problem.

Eighty-five per cent magnesia, highly efficient and satisfactory for general conditions, is not well suited to use with temperatures over 600 deg. F. At such temperatures it calcines to a depth that causes serious disintegration. Shrinkage of volume to the extent of about 15 per cent occurs, causing the material to crack and the joints to open, thus increasing the heat losses.

To meet the need for an insulation that will be dependable at these high temperatures, Johns-Manville, Inc., 296 Madison Ave., New York, has placed on the market a new material called "Johns-Manville High-Temperature Insulation." When this material is used in combination with 85 per cent magnesia or other insulating materials, it is called "High-Temperature Combination Insulation."

In using this new material, the makers recommend that the pipe or surface to be insulated be first covered with a thickness of the high-temperature insulation, which will reduce the temperature to a point that makes it practical to apply over it a more efficient material. Then, as shown in Fig. 1, 85 per cent magnesia or other suitable insulation is applied over the high-temperature insulation.

When it is desired to insulate flat surfaces, tanks or apparatus of irregular shape, the same material can be obtained under the name of "Johns-Manville Fire Backing." It is also recommended that this be used in combination with 85 per cent magnesia or other suitable insulation. Fig. 2 shows how this form of high-temperature insulation is applied.

The material itself is of a refractory nature, having ability to resist temperatures up to 1,200 deg. F. and having good insulating value. It is claimed that in combination as above outlined it gives an efficiency far superior to either material alone and gives the maximum insulating value consistent with high heat resistance.

It is composed of refractory material, asbestos fiber and other suitable ele-

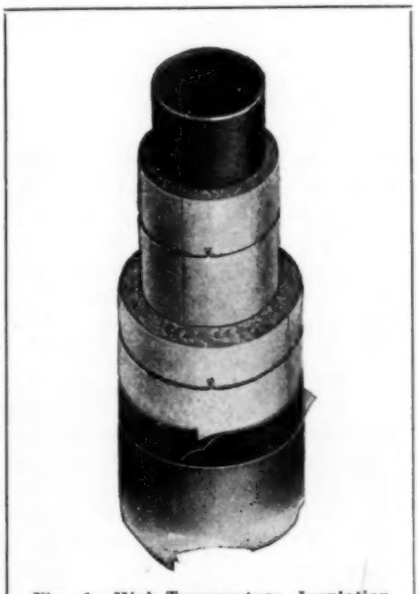


Fig. 1—High-Temperature Insulation Applied to a Pipe, With an Outside Cover of 85 Per Cent Magnesia

Fig. 2—High-Temperature Insulation Applied to Tank, 85 Per Cent Magnesia for Outer Layer

ments. The mechanical strength is high and, due to its low shrinkage, even at 1,200 deg. F., it has great durability.

In Fig. 3 is shown a comparison between heat losses from bare and properly insulated surfaces. The upper curve is for bare surfaces and the lower series of curves for insulations best suited to the various ranges of temperature. The space between shows graphically the savings due to insulation.

Acid Valve With Union Connection

A new lightweight, compact design of acid-resisting valve for use with lead pipe or lead-lined iron pipe in the smaller sizes has recently been placed on the market by the Resisto Pipe & Valve Co., East Cambridge, Mass. This valve has been designed to take the place of the plug cocks usually employed, in order to overcome the freezing experienced with them.

The valve is of the lead-lined Y type and is provided with union connections. Because of the unions and the consequent elimination of flanges and also because of the elimination of outside screw and yoke, it is much lighter and more compact than former designs and yet sacrifices nothing in efficiency. It is claimed by the makers to be absolutely tight. The new design of handwheel and nut is said to keep the steam travel as straight as would the much heavier outside screw and yoke. This travel is guided by substantial lead gibs on inside of valve, as shown in section AA of the accompanying cut.

The barrel of this valve has been made extra large to allow space for guiding lugs on the disk and thus obviate any chance of back pressure on the disk when opening the valve. Installation is simple. For lead pipe connection the pipe is turned over the tailpiece of the union and then made up. For lead-lined pipe a lead-lined union is furnished. The valve is also furnished lined with block tin for use with block tin pipe or tin-lined iron pipe.

Manufacturers' Latest Publications

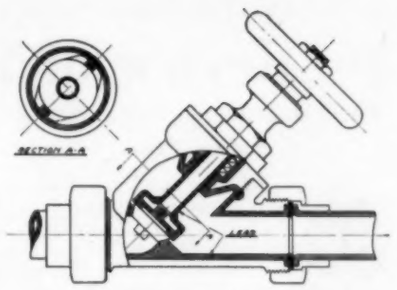
Premier Mill Corp., Geneva, N. Y.—A folder announcing the opening of the new laboratories and demonstrating plant of this company at Geneva.

The Eagle-Picher Lead Co., Chicago, Ill.—A folder dealing with methods of rust-proofing by the use of sublimed blue lead.

L. J. Wing Mfg. Co., 352 West 14th St., New York City—Bulletin 26. A bulletin describing the type EM blower for use in burning small anthracite, screenings and slack.

Clement K. Quinn & Co., Alworth Bldg., Duluth, Minn.—Three booklets, the first entitled "The Improved Manganiferous Iron Ores," describing their use and effect; the second, entitled "The Use of High Manganese in the Basic Open Hearth," being a reprint of a paper by E. A. Weeks, superintendent open-hearth department, Bethlehem Steel Co., read at the October, 1920, meeting of the American Iron & Steel Institute; and the third, a booklet on 1924 Analyses of Lake Superior Iron Ores.

Weston Electrical Instrument Co., Newark, N. J.—A booklet entitled "Electrical Savings," which deals with the use of electrical instruments in improving the efficiency of use of electrical energy in industrial plants.



Lightweight Acid Valve

The Northern Blower Co., Cleveland, O.—Bulletin F1002. A bulletin giving design and specification data on "Norblo" slow speed exhaust fans.

Hooker Electrochemical Co., 25 Pine St., New York City—Bulletin 2. A new bulletin on liquid chlorine.

C.M.S., Inc., Tarrytown, N. Y.—Bulletin 110. A new bulletin describing the C.M.S. portable one-man conveyor oven for use in making enamels.

The Cambridge & Paul Instrument Co., Ltd., 45 Grosvenor Place, London, S. W. 1, England—A bulletin on the Cambridge type of electrical CO_2 indicator and recorder.

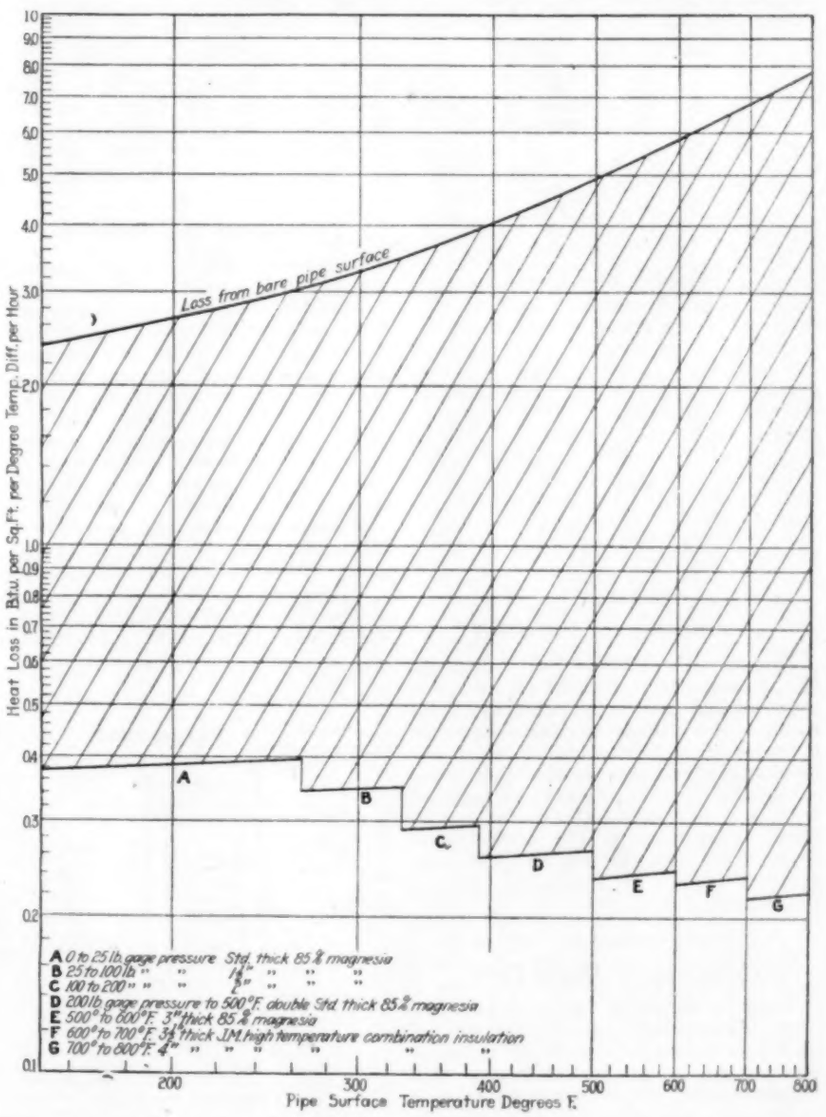
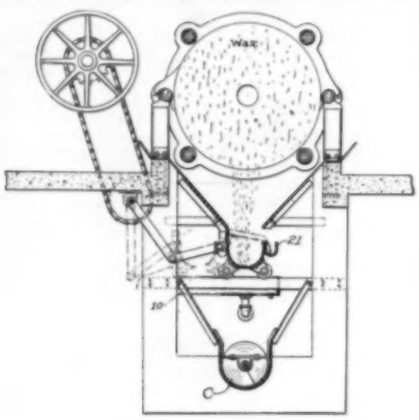

Heat Loss in Btu per Sq.Ft. per Degree Temp. Diff. per Hour
Pipe Surface Temperature Degrees F.
Loss from bare pipe surface
A
B
C
D
E
F
G
A 0 to 25 lb. gage pressure Std. thick 85% magnesia
B 25 to 100 lb. " " " 1½" " " "
C 100 to 200 " " " " 2" " " "
D 200 lb. gage pressure to 500°F. double Std. thick 85% magnesia
E 500° to 600°F. 3" thick 85% magnesia
F 600° to 700°F. 3½ thick J.M. high temperature combination insulation
G 700° to 800°F. 4" " " " " " "

Fig. 3—Heat Losses From Bare Surfaces and From Surfaces Insulated With Economical Thickness of Insulation

Review of Recent Patents

Wax Press

Features of construction embodied in a new design of paraffine wax press by Alanson McD. Gray, of Elizabeth, N. J., may be summed up as follows: (1) A mechanical arrangement for moving the oil trough out of the way so that the wax cakes may be dropped. While the press is being filled the oil flowing through the press cloths is caught in trough 10. When wax is to be discharged into the screw conveyor *C*, the trough 10 must be moved back out of the way. Instead of accomplishing this by direct manual effort, the movement of the trough is effected by means of a



Paraffine Wax Press

series of levers attached to a shaft operated by a hand-wheel. (2) Devices for preventing contaminated oil from getting into the good oil. Alongside of the trough 10 is an auxiliary trough 21 and small movable transverse gutters may be placed across trough 10 under any press chambers where the cloth may have broken, thus diverting the contaminated oil to trough 21. (1,485,391; March 4, 1924; assigned to M. W. Kellogg Co.)

Purification of Fusel Oil

Herman F. Willkie, of Baltimore, Md., has shown that fusel oil or crude amyl alcohol may be purified by treatment with a neutral oxidizing agent at a temperature below that at which the oxidizing agent attacks the amyl alcohol itself. The fusel oil may be agitated with a 4 per cent solution of potassium permanganate, the temperature being kept below 25 deg. C. (1,485,940, assigned to U. S. Industrial Alcohol Co., March 4, 1924.)

Cyclohexane Motor Fuel

Used as a motor fuel for airplane work, cyclohexane permits the use of high compressions at low altitudes without the development of knock. The disadvantage of the high freezing point (0 deg. C.) is overcome by Thomas Midgley, Jr., of Dayton, Ohio, through the addition of benzene. A mixture of cyclohexane and benzene in the ratio of 80 parts by volume of the former to 20 of the latter gives an excellent fuel with a freezing point of minus 40 deg. F. (1,491,998, April 29, 1924, assigned to General Motors Research Corporation, Dayton, Ohio.)

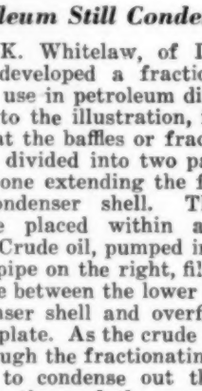
Protective Coating Containing Latex

In view of the composition of rubber latex (rubber 30 per cent, proteids 10, water 50, with variable amounts of resins) and particularly on account of its rubber content it appears that if the solid constitutents of latex, either alone or in combination with other materials such as oils and pigments, could be deposited upon surfaces in the form of films, valuable protective coatings would be obtained. It is, however, necessary to stabilize the latex, as it coagulates easily.

Henry A. Gardner, of Washington, D. C., has found that alkalis such as caustic soda or ammonia will stabilize the latex so that it may be mixed with oils or pigments to form a paint that dries to a tough durable film of high moisture resistance and protective properties. (1,492,027, April 29, 1924.)

Petroleum Still Condenser

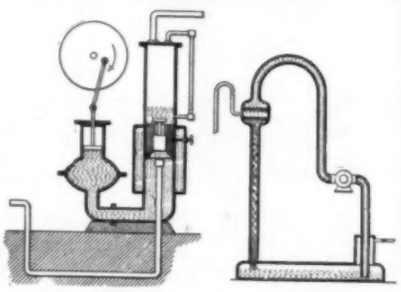
Arthur K. Whitelaw, of Louisville, Ky., has developed a fractional condenser for use in petroleum distillation. Referring to the illustration, it will be noticed that the baffles or fractionating plates are divided into two parts, only the upper one extending the full width of the condenser shell. The lower baffles are placed within a smaller cylinder. Crude oil, pumped in through the lower pipe on the right, fills the annular space between the lower baffle and the condenser shell and overflows onto the upper plate. As the crude oil passes down through the fractionating column, it serves to condense out the higher boiling fractions of the vapors which are rising through the column from the still. The crude oil is also preheated by this means to a temperature that is sufficient to remove some of the lighter fractions before the main portion of the crude reaches the still. (1,488,422; assigned to Standard Oil Co. of Kentucky; March 25, 1924.)



Fractional Condenser

Chlorine Compressors

In pumps for compressing chlorine, fish oil or concentrated sulphuric acid has commonly been used. Howard S. McQuaid, of Edgewood, Md., and Roy C. Mitchell, of East Woodbury, N. J., have found that petroleum ether or a similar petroleum fraction when completely saturated with chlorine has many advantages for use in chlorine compressors. It is not hygroscopic, does not become gummy through reaction with chlorine as does fish oil, does not corrode metal and in addition is a good lubricant. It may be used in the types of compressors shown in the accompanying figure or in rotary types such as the Nash Hytor. (1,492,391, April 29, 1924.)



Chlorine Compressors

Left—Reciprocating liquid plunger type suitable for liquefying chlorine. Right—Type in which falling column of liquid is used.

Decolorizing Clays

Instead of treating clays such as montmorillonite, diatomaceous earth, etc., with 25 to 50 per cent by weight of sulphuric acid and washing out the reaction products in order to obtain a clay with good decolorizing properties, James W. Kier, of Fillmore, Calif., and John C. Black, of Destrehan, La., have found it preferable to use smaller amounts of acid and to leave the reaction products in the clay. Sulphuric or hydrochloric acid in amounts not exceeding 10 per cent by weight of clay is added either to the dry pulverized clay or to a clay mud, and the mixture is dried to form the finished product. (1,492,184; April 29, 1924.)

Precipitating Gold and Silver With Silicon

Frederick M. Becket, of New York, suggests the use of metallic silicon or certain silicon alloys for precipitating gold and silver from cyanide solutions, the reaction proceeding according to the equation:

$$4NaAg(CN)_2 + Si + 6NaOH = 8NaCN + 4Ag + Na_2SiO_3 + 3H_2O$$

Because of its low atomic weight and high chemical equivalence, silicon has a theoretical reducing power per unit weight which is greater than that

of either aluminum or zinc. Furthermore, it will be noted that sodium cyanide is regenerated in the precipitation step. In using silicon alone the cyanide solution must be quite alkaline, but alloys with 3 to 20 per cent calcium give excellent results with less alkaline solutions. (1,492,282 and 1,492,283; assigned to Union Carbide & Carbon Research Laboratories, Inc., Long Island City, N. Y.; April 29, 1924.)

Lithopone

Louis C. Drefahl and Edward A. Taylor, of Cleveland, Ohio, have developed a process that yields lithopone having the following characteristics as compared with the ordinary product:

	Ordinary Product	New Product
Color dry	AA	AA+
Color oil	A	AA—
Obscuring power	90	125
Oil absorption	11.6	19
Volume	98	180
Fineness	98.51	99.9
Sun test in water	Not sunproof.	Sunproof.

The barium sulphide is prepared as usual, but the zinc sulphate solution must be as free as practicable from impurities, particularly water-soluble inorganic salts.

The zinc sulphate and barium sulphide solutions are then brought together in the usual way as regards the manner of mixing the solutions, proportions of reagents, temperature of operation and other standard conditions, excepting that instead of the conditioning agents heretofore employed a small amount of a solution of an alkali metal silicate is used. A solution of sodium silicate of 42½ deg. Bé. containing about 9 per cent Na_2O and 30 per cent SiO_2—that is, sodium oxide and silica in the ratio of about 3.25 to 1—has been found to be suitable.

When the sodium silicate has been added and thoroughly mixed with the precipitate, the product is dried, calcined in a muffle furnace, etc., according to the usual methods of making lithopone. (1,486,077; March 4, 1924; assigned to Grasselli Chemical Co., Cleveland.)

Drying Milk

David D. Peebles, of Eureka, Cal., has developed a method of producing a curdled milk containing all of the food constituents of the milk. The product may be used for cheese manufacture or dried and pulverized. The milk is first evaporated or concentrated in a suitable form of evaporator until approximately 80 per cent of the water content has been removed. A curdling agent is then added—for instance, an acid or preferably rennet—and the curd thus formed is so compact or solid that the whey is mechanically retained. The curd thus obtained may be employed for the manufacture of cheese, if it is produced from fresh milk, and in some instances even though it be produced from skim milk. Again, the curd produced may be employed for the purpose of manufacturing dried milk, as it will be necessary only to subject the curdled milk to a drying action that will remove the remaining vapor content. The dried curdled milk may then be ground as fine as desired and may be used as a stock feed or otherwise. Experience has shown that the dried curdled milk may be advantageously employed for cooking wherever milk is required, or that it may be used directly as a food for human consumption, the product being eaten either dry or moist. (1,491,166; April 22, 1924; assigned to Western Condensing Co., Eureka, Calif.)

U. S. Patents Issued May 20, 1924

These patents have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Cane Mill. Luis Diaz Hidalgo, Habana, Cuba.—1,494,357.

Method and Apparatus for Making Pulp Articles. Felix Louisot, New York, N. Y., assignor to Vacuum Pulp Products Corporation, New York.—1,494,362.

Method of Making Alloys. Richard Walter, Düsseldorf, Germany.—1,494,393.

Dye from Dioxyperylene. Alois Zinke and Albert Klingler, Graz, Austria, assignors, by mesne assignments, to Perylene Co., Inc., New York.—1,494,400.

Suction Device for Press Rolls and the Like. L. Kutter, Hamilton, Ohio.—1,494,432.

Sulphur-Oxidizing Organism and Method of Producing the Same. Jacob G. Lipman, New Brunswick, N. J.—1,494,434.

Method and Means for Producing Sulphofying Bacteria. Jacob Goodale Lipman, New Brunswick, N. J.—1,494,435.

Method of Burning Aqueous Liquids Containing Sulphite Waste Lye. Emil Eisenbeiss, Perlen, near Lucerne, Switzerland.—1,494,468.

Cellulose-Ether Solvent and Composition. Edward S. Farrow, Jr., Rochester, N. Y., assignor to Eastman Kodak Co., Rochester, N. Y.—1,494,469-1,494,476.

Screen for Paper Stock. Ralph S. Clarke, Walpole, Mass., assignor to Bird Machine Co.—1,494,529.

Plant and Retort for Treatment of Wood, Etc. Frederick K. Fish, Jr., San Francisco, Calif.—1,494,536.

Humidity Regulator. John Johnston, New Haven, Conn., assignor to Western Electric Co., Inc., New York.—1,494,551.

Method of and Apparatus for Measuring Temperatures. Charles R. Cary, Philadelphia, Pa., assignor to Leeds & Northrup Co., Philadelphia.—1,494,586.

Thermally Responsive Electric Switch. John Twardowsky, Chicago, Ill., assignor, by mesne assignments, to Universe Corporation, Chicago.—1,494,650.

Chemicomechanical Process for Making an Unalterable White Pigment. Adolph Dworzak, St. Louis, Mo.—1,494,674.

Liquid Filter. Harvey Feldmeier, Little Falls, N. Y., assignor to D. H. Burrell & Co., Inc., Little Falls, N. Y.—1,494,677.

Apparatus for Separating Floating and Other Impurities in Suspension From Liquids. Cuthbert George Petree, Brisbane, Australia.—1,494,704.

Winning Ammonium Gas. Augustus Steiger Cooper, Santa Barbara, Calif.—1,494,735.

Process of Manufacturing Cellulose Acetate. Robert W. Cook, Rochester, —1,494,816.

Process of Manufacturing Cellulose Acetate. Robert W. Cook, Rochester, N. Y.—1,494,830.

Process for the Production of Alumina. Birger Fjeld Halvorsen, Christiania, Norway, assignor to Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Christiana, Norway.—1,494,835.

Process of Manufacturing Carbazol Derivatives. Frederick William Atack, Charleston, W. Va.—1,494,879.

Organic Bismuth Compound. Oscar Bally, Basel, Switzerland, assignor to the Firm Haco-Gesellschaft A.-G. Bern, Bern, Switzerland.—1,494,943.

Composition of Matter for Motor Fuel. Wilbur G. Dunning, Philadelphia, Pa.—1,495,005.

Vulcanizing Apparatus. Walter Kirkbank Fletcher and John Rushmer, London, England.—1,495,009.

Evaporator. Clark Orr, Fort Wayne, Ind., assignor to General Electric Co.—1,495,034.

Utilization of Cellulose Liquors. Addison F. Hoffman, Pittsburgh, Pa.—1,495,074.

Centrifugal Drier. Henry Patrick Hoyle, Durham, England.—1,495,075.

Apparatus for the Separation and Classification of Solid Materials. Ernest Pinoche, Cousancelles, France, assignor to Fernand Radelet, Brussels, Belgium.—1,495,106.

Reversing-Furnace Mechanism. Marcus C. Steese, Hamburg, N. Y.—1,495,119.

Books Received

Electrolytic Chlorine Cells

DIE TECHNISCHE CHLORALKALI-ELEKTROLYSE (Technical Electrolysis of Alkali Chlorides). By *Dr. J. Billiter*, of the University of Vienna. Volume II of the Fortschritte der chemischen Technologie in Einzeldarstellungen, edited by Prof. Dr. B. Rassow, Leipzig. 80 pages, 20 illustrations. Theodor Steinkopff, Dresden. Price, 60c.

Commercial types of electrolytic cells for the production of chlorine and caustice soda, hypochlorites, chlorates and perchlorates are reviewed in this book, the essential characteristics of each design being given. Chlorine cells are considered in six groups as follows: I—Griesheim-Elektron, McDonald; II—Finlay, Badische, Bayer, Barth, Billiter; III—Hargreaves-Bird, Townsend, Allen-Moore, Nelson; IV—LeSueur, Siemens-Billiter; V—Aussiger Glockenverfahren, Johanns, Billiter-Leykam; VI—mercury cathode cells, such as Castner, Kellner, Solvay, Whiting, Wilderman. Having been active in the development of several cells, Dr. Billiter speaks with authority.

Writings of Adolf Frank

AUSGEWÄHLTE VORTRÄGE UND SCHRIFTEN VON ADOLF FRANK (Selected Addresses and Writings of Adolf Frank). Edited by *Prof. Dr. H. Grossmann*. 291 pages, 14 illustrations. M. Krayn, Berlin. Price $2.50.

From the extensive scientific and technical work of Adolf Frank, representative selections have been gathered together in book form, the collection serving admirably to reflect the versatility of this famous German chemist. The material has been grouped under the following heads: Potash salts; utilization of thomas slag; calcium carbide and acetylene, cyanamide, hydrogen; chemical industry and agriculture; peat utilization; cellulose; mosaic and

glass industries; garbage disposal; technical travel notes and reminiscences.

Electric Steel Furnaces

DIE ELEKTROSTAHLÖFEN. By *E. Fr. Russ.* 471 pages, 439 illustrations. R. Oldenbourg, Munich. Price, paper, 14, goldmarks; bound, 15.50 goldmarks (4.20 goldmarks = $1.)

Discussions of fundamental electrical technology and its application to electric furnace problems are followed by comprehensive sections on design and operating characteristics of the commercial electric steel furnace and on the constituent parts and accessories such as electrodes, regulating devices for electrodes; voltage, etc., and measuring instruments. Nearly half of the book is devoted to the consideration of different furnaces, classified as follows: Radiation—Stassano, Bonner, Rennerfelt; Indirect Arc—Heroult, Vom Baur, Ludlum, Moore, Fiat, Weff; Arc-Resistance—Girod, Keller, Chaplet, Nathusius, Greaves-Etchells, Grönwall-Dixon, Booth-Hall, Russ; Induction—Kiellin, Fink, Röchling-Rodenhauser, Hiorth, Gassies-Jeramec, Ajax-Wyatt.

Acetic Acid

DIE ESSIGSÄURE, IHRE GEWINNUNG UND WIRTSCHAFTLICHE BEDEUTUNG (Acetic Acid, Its Production and Economic Significance). By *Dr. Viktoria Kessler.* 118 pages. M. Krayn, Berlin. Price, 65c.

After a brief review of the methods of making acetic acid by fermentation and by treatment of calcium acetate and calcium carbide, the author turns to the economic considerations of the industry, which occupy the major portion of the book. Such factors as production costs, plant location, trade, tariff and competition among the different branches of the industry are considered at some length.

Iron and Steel Industry

GEMEINFASSLICHE DARSTELLUNG DES EISENHÜTTENWESENS (General Description of Iron and Steel Plants). Edited by the *German Iron and Steel Institute* (Verein Deutscher Eisenhüttenleute, Düsseldorf). Twelfth edition, 661 pages, illustrated. Obtainable from Paul F. Hermann, Century Bldg., Pittsburgh. Price, $3.40.

Although this publication does not appear annually, the first edition having been printed in 1889, it resembles a year book of the German iron and steel industry, with perhaps more technical information than is usual in such works. Indeed, the first 263 pages are devoted to a review of the technology of iron and steel production. Then follows nearly 300 pages of economic data, with statistics for more than thirty foreign countries in addition to a very thorough treatment of the industrial status of the industry in Germany. A directory of the industry completes the volume. Tables show the equipment of blast furnaces, steel plants and rolling mills. Nearly 2,000 foundries are listed alphabetically with geographical index.

Spontaneous Combustion of Charcoal

OM TRÄKOLS SJÄLVANTÄNDNING (Spontaneous Combustion of Charcoal). By *Hilding Bergstrom.* Bulletin 25, Ingeniorsvetenskapsakademien, A.-B. Gunnar Tisells Tekniska Forlag, Stockholm. Price, 2 krona.

In the studies reported, it was found that the rate of oxygen absorption is in general greater for charcoal produced in ovens than for the pit product, a production temperature of 425 deg. C. giving the highest rate of absorption. The oxidation of charcoal during storage does not improve the quality for iron production, as is commonly believed. By rational storage and control of temperature in storage piles spontaneous ignition of charcoal can be prevented. A simple method for determining the relative tendency toward spontaneous combustion is described.

Electrodeposition

DIE GALVANISCHEN METALLNIEDERSCHLÄGE UND DEREN AUSFUHRUNG (Practice of Electrodeposition). By *Hubert Steinach* and *Georg Buchner.* Fourth edition, revised by Georg Buchner and Dr. Alfred Wogrinz. 188 pages, 37 illustrations. M. Krayn, Berlin. Price, $1.50.

ELEKTROLYTISCHE METALL-ABSCHEIDUNGEN (Electrodeposition). By *Georg Buchner.* Second edition, 304 pages, illustrated. M. Krayn, Berlin. Price, $2.50.

These two books should be considered together, as the first contains the elements of the practice of electrodeposition and the second supplements this with more advanced and detailed information. Together they form a very useful and practical treatment of electroplating and related subjects.

Sankey Diagrams for Steel Industry

WÄRMESTROM-BILDER AUS DEM EISENHÜTTENWESENS. (Sankey Diagrams for Iron and Steel Plants). Prepared by the *Heat Economy Bureau* of the German Iron and Steel Institute. 20 pages. Obtainable from Paul F. Hermann, Century Bldg., Pittsburgh. Price, 70c.

In this book the familiar Sankey diagrams showing heat distribution have been employed to show heat energy conditions in iron and steel plants. Diagrams are given for coke ovens, blast furnaces, blast-furnace gas distribution, converters, gas producers, open hearth, waste heat boilers, complete iron and steel plant; and wire mill. In addition there are tables of data that make the diagrams of most practical interest.

Corrosion of Cans

CANNED FOOD CONTAINERS. Investigation by a committee representing the National Canners Association, American Can Co., and Titanium Alloy Manufacturing Co. Published by the National Canners Association, Washington, D. C., as Research Laboratory Bulletin 22-L.

The relation of the quality of tin plate to the service value of cans for food products has been discussed for years. Various factors have been held responsible for troubles experienced by canners and numerous investigations have been undertaken. The latest study of importance, that on resistance of tin plate to perforation, is described.

The report of the committee presents: first, a summary of the results of the entire investigation; second, a record of each phase from the making of the steel to the final inspection of the canned products; third, appendices giving basic data. The method of presentation is such as to enable those interested in the subject to follow the work and its results to whatever degree of detail they may desire.

Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. A brief résumé of each article is included in the reference given. Since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage.

"Increasing Production by Good Lighting." *Fred L. Prentiss.* An account of studies showing how production increases and fatigue lessens when lighting conditions are improved. *Iron Age,* May 8, 1924, pp. 1343-44.

"Natural Gas Developments During 1923." *E. G. Sievess.* An economic study of progress in natural gas recovery and use during the past year. *Gas Age-Record,* May 10, 1924, pp. 635-8.

"The Holmboe Electrolytic Hydrogen Generator." *Marc Hanssen.* Description of Norwegian industrial development. *Chem. & Ind.,* May 2, 1924, pp. 458-9.

"The Corrosion of Copper and Copper Alloys." *Ulick R. Evans. J. Soc. Chem. Ind.,* May 2, 1924, pp. 127T-131T.

"The Relation of p_H to the Corrosion of Iron." *J. W. Shipley* and *Ivan R. McHaffie.* Mechanism of corrosion and graphitic softening. *Can. Chem. & Met.,* May, 1924, pp. 121-4.

"Evaporating and Drying Plant." *S. G. Ure.* Parts II and III of an exposition of equipments, mostly of British origin. *Chem. & Ind.,* April 4 and 11, 1924, pp. 350-4, 374-9.

"Savings Effected by Use of Stabilizer in Natural Gasoline Plants." *Lloyd F. Bayer.* Experience of Tidal Refining Co. in use of patented tower for continuous distillation. Results in removing propane. *Nat. Petroleum News,* April 30, 1924, pp. 24-9.

"Linseed Oil and Its Applications." *H. de la Condamine.* Third installment of this article deals with extraction methods. *L'industrie Chemique,* April, 1924, pp. 156-9.

"Operations of the Anglo-Persian Oil Co." *André Sée.* Development and present status of this important factor in petroleum industry. *La Technique Moderne,* April 15, 1924, pp. 284-93.

News of the Industry

Summary of the Week

Ford's chances of obtaining Muscle Shoals are practically blasted. Norris bill favorably reported, but final action at present session continues to be doubtful.

Electrochemical development in Northwest regarded probable following completion of Columbia dam.

Senate authorizes appropriation of $500,000 to investigate potash resources of United States.

Members of chemical trade are interested in having a trade commission in South America as well as in Europe.

Industrial preparedness proves to be main theme of Cleveland meeting of the A.S.M.E.

Symposium on absorption planned at fall meeting of American Chemical Society at Ithaca.

Synthetic methyl alcohol process reported in Germany.

Brown University to give new degree of Bachelor of Science in Chemistry.

Import and export trade in chemicals and allied products in April was far below totals for April, 1923.

Field for Trade Commissioner in South America

The discussion within the chemical industry as to the benefits of the maintenance of a chemical trade commissioner in Europe has revealed the fact that the industry is just as interested in having a chemical trade commissioner in South America. It is pointed out that South America constitutes the most important potential foreign field for the American chemical manufacturer. It is emphasized, however, that a trade commissioner in Europe is just as essential. The function of these two trade commissioners is very different. The man in Europe serves in a protective capacity and furnishes facts as to the conduct of the more highly developed industries for the guidance of American manufacturers. The man in South America would deal largely with trade extension.

While South America will continue for generations as a continent engaged principally in agriculture and the production of raw materials, it is pointed out that agriculture is becoming one of the chemical industries' best customers. Even virgin land needs fertilizers. Most crops require insecticides. Industries, however, are developing in South America and with them comes a demand for the wide range for chemical commodities they must use. There is a large and an immediate market available for fertilizers, particularly the phosphates, for pharmaceuticals and for insecticides.

The United States has a trade advantage in the fact that it has large phosphate deposits practically at tide water. This is an important advantage over our most formidable competitor, Morocco. The Moroccans have a long and expensive rail haul to tide water and are at a geographical disadvantage in so far as South America is concerned. Another advantage to the United States lies in the fact that our consumption of South American products covers such a wide range that a return cargo is assured for the ships that carry heavy chemicals to the South American ports.

South America is confronted with the urgent necessity of extensive sanitary campaigns. This insures the fact that it will be in the market permanently for the chemical commodities essential to these efforts.

Round-Table Discussion on Refractories

An interesting feature of the meeting of the New York section of the American Electrochemical Society, Friday evening, May 23, was the attempt to develop more of a spirit of informality than has been customary in New York section meetings. An informal supper at the Midtown Restaurant was followed by a round-table discussion on refractories. This was opened by J. H. Critchett, of the Union Carbon & Carbide Research Laboratories, who outlined the present status of zirconia refractories and emphasized the need for a more satisfactory bonding material. Dr. E. F. Kern, professor of electrometallurgy at Columbia University, presented the results of some studies on the effect of adding magnesia and carbon to fireclay refractories. Carbon addition greatly reduces the penetration of metal vapors. Frank Farnsworth, of the Western Electric Co., discussed the manufacture and properties of electrical porcelain. Each subject aroused lively discussion.

Officers were elected for the coming year as follows: Paul V. D. Manning, chairman; A. L. Feild, vice-chairman; Robert M. Burns, secretary-treasurer.

Uses of Alcohol Increasing in Various Industries

Recent developments in the industrial alcohol industry have been outlined by J. M. Doran, of the Industrial Alcohol and Chemical Division of the Prohibition Unit, for the American Chemical Society. Beyond indicating the great importance of automobiles, consuming millions of gallons annually in the form of an anti-freeze mixture, he points out that dehydration by distillation is an advance that has considerable significance.

"Alcohol fuels have from time to time been satisfactorily used in internal combustion engines where the economic factors are favorable. The presence of 5 per cent of water in high-proof alcohol has been a serious handicap to its use as a component part of a blended fuel.

"The dehydration of alcohol by continuous distillation and at a reasonable cost has therefore removed one serious defect in the alcohol-blended fuel, and today it occupies the position of being at once available and profitable to use should the petroleum distillates increase substantially in price.

"The production of absolute alcohol by distillation has made it available for research work at a cost very much less than heretofore. The possibility of the procurement of absolute alcohol at a moderate cost for use in various synthetic processes has been of great assistance to the industries concerned.

"The recent announcement of the commercial availability of tetra-ethyl lead as an anti-detonator for rendering motor operation more efficient serves to illustrate the essential relationship of ethyl alcohol to the combustion engine, even though in this case the ethyl compound is employed for purposes other than direct power generation."

Ford's Chances of Getting Muscle Shoals Blasted

Norris Bill Providing Government Control Is Favorably Reported—Final Action at Present Session Doubtful

The federal government will not sell its Muscle Shoals properties to Henry Ford. This deduction is placed, by most observers, on the action of the Committee on Agriculture of the Senate, which on May 27 voted 11 to 5 against the McKenzie bill, which embodies the Ford offer. The committee then voted to report favorably Senator Norris' bill, which provides for a modified form of government operation.

Those who believe that the committee's action killed the Ford bill based their reasoning on the assumption that even should the Senate pass on the Norris bill, of which there is some doubt, the resulting conference between the two houses would end in a deadlock. Mr. Ford would not accept the compromise measure on which the Senate conferees would insist. In turn, the Senate would not accept a conference bill which would embody the few concessions which Mr. Ford might accept. It is expected, however, that the Norris bill will be taken up by the Senate during the week of June 2, which will mean that there will be extended discussion of the disposition of Muscle Shoals.

No votes were taken in the committee on the other offers. It was so apparent that all of them would be voted down that no member of the committee moved to vote on them.

A sub-committee consisting of Chairman Norris, Ransdell of Louisiana and McNary of Oregon was authorized to draft any amendments to the Norris bill as may be deemed necessary to perfect it. The amendments, however, must be reported back to the full committee for approval. The principal provisions of the Norris bill are as follows:

Provisions of Bill Reported

The Secretary of War is directed to complete Dam No. 2 (the Wilson dam) and Dam No. 3. Surveys of reservoir sites with the idea of increasing the amount of primary power. The creation of the Federal Chemical Corporation, which is authorized to use the power and the government's plants for the manufacture of explosives for the government and the manufacture of fertilizer for sale to the public. Any and all power not required by the nitrate plants may be sold. The corporation may establish agencies for the sale of its products "in order to prevent a monopoly of the fertilizer business or the undue or unreasonable advance in the price of fertilizer."

The majority of the Senate doubtless would vote to allow the government to operate the dam. But it is not believed that any proposal that would launch into the manufacture of fertilizer will be approved. As this is written, it seems probable that Congress will adjourn on June 7. It is regarded that this will not allow enough time to perfect a bill which the Senate will approve. The probabilities are that the disposition of the matter will be allowed to go over until the December session. A definite course might be provided at an earlier date should this session of Congress be continued after the political conventions.

How the Senators Voted

The five Senators who voted to report the Ford bill favorably were Harrison of Mississippi, Heflin of Alabama, Caraway of Arkansas, Smith of South Carolina and Ladd of North Dakota. Senator Ralston of Indiana voted present. He does not approve of the Ford offer, but had committed himself in such a way that he felt he should not be a party to its defeat. There were five votes also against the Norris bill. Senator Ladd voted for it, but Senator Keyes of New Hampshire voted against it. The four other votes against the Norris bill were those cast for the Ford bill.

It was admitted in the committee that the principal point influencing the majority was the fact that the distribution of the power over as wide an area as possible is desirable.

Industrial Preparedness Main Topic of Engineers' Meeting

A.S.M.E. Spring Session in Cleveland Considers This and Other Important Topics

THE essential basic unity of all branches of the engineering profession was again demonstrated when the American Society of Mechanical Engineers met in Cleveland, Ohio, May 26 to 29 for its annual spring meeting. Included in a program which treated, as was to be expected, of machine shop and power plant practice, were many papers of general interest to all engineers; and some of particular moment to the chemical engineer and to the metallurgist.

Perhaps the high spot of the meeting was the session on "Industrial Preparedness," at which former Major-General Williams, chief of ordnance, Benedict Crowell, former head of the War Industries Board, Assistant Secretary of War Dwight F. Davis and Bernard M. Baruch were the speakers. Motion picture films showing the most recent activities of the War Department were presented. The message of this session was that of the great industrial preparedness dinner held in New York last winter—that industry must prepare and organize to the end that, in the event of another war, there may be no delay in the production of the necessary material; and that it is the engineers who should lead the way in this work.

Of greatest immediate importance were the sessions of the Materials Handling Division and the public hearing on the report of the committee on application of formulas, Materials Handling Division. The need of adequate formulas by which the economy and performance of handling equipment may be measured has long been felt by engineers. The proceedings at these meetings, some of which will be printed later in *Chem. & Met.*, should do much to clarify the situation. No clearer statement of the fundamental need of the proper use of labor-saving devices than the paper read by Professor Begeman, of the University of Michigan, could be made. While there was much discussion over certain of the details of this paper and of the formulas presented, the impression was given that these differences of opinion will soon be cleared up and that there will be a universal standard method by which the advantages of any given material-handling installation may be determined.

The American Society for Testing Materials and the A.S.M.E. held a joint session on the effect of temperature upon the properties of metals. L. W. Spring, chief chemist of the Crane Co., gave a paper on "Industrial Applications of Metals at Various Temperatures." Other papers were given on "Methods of Testing at Various Temperatures," by V. T. Malcolm; "Available Data on the Properties of Irons and Steels at Various Temperatures," by H. J. French and W. A. Tucker; and "Available Data on the Properties of Non-Ferrous Metals and Alloys at Various Temperatures," by C. Upthegrove and A. E. White. These papers are to be published by the A.S.T.M., and a review of them will appear in a later issue of *Chem. & Met.*

Among the many topics treated of general interest were the measurement of management, education and training for the industries, and heat transmission and insulation. W. L. R. Emmet, of the General Electric Co., gave a much more extended account of the mercury vapor boiler than that recently printed in these pages. He now states that there is considerable promise of a more copious supply of mercury than we now have being available as demanded. He also recounted tests made with a binary vapor boiler using sulphur vapor in combination with water vapor and mentioned the use of diphenyl, diphenyl ether and benzophenone. It is the opinion of the author that mercury presents the greatest possibilities.

Many interesting excursions were made by those attending the meeting, including a day at Nela Park, the General Electric Co.'s research laboratories for lighting; a trip through the B. F. Goodrich Co. plant in Akron; and a visit to the steel mills and byproduct coke plant of the National Tube Co. at Lorain, Ohio.

Plans for Purchase of Southern Cotton Oil Co.

Reports from Savannah state that arrangements have been made by private interests to purchase the stock of the Southern Cotton Oil Co. and establish the latter as an independent company. The Southern Cotton Oil Co. is now a subsidiary of the Virginia-Carolina Chemical Co.

Washington News

Appropriation for Potash Search Passes Senate

No voice was raised against the proposal to expend $500,000 in prospecting for potash in the Southwest when Senator Sheppard's bill came before the Senate. The bill was passed without the formality of a roll call. The Committee on Agriculture of the Senate, in recommending the passage of the measure, made a report stating that information now available indicates the contemplated investigation is very likely to net worth-while results. In view of the fact that we are expending about $15,500,000 for potash from Germany and France and in view of the need of an independent domestic supply of an element so essential to national subsistence and defense, the Committee on Agriculture and Forestry believes that the country may well afford to expend this sum for the purpose indicated.

The Bureau of Soils has also found that among the waste materials of the cement, blast-furnace, beet sugar, distilling and wool-scouring industries, and the natural raw materials, such as the green sands of New Jersey, the leucites of Wyoming, the alunites of Utah, the natural brines of Nebraska, Utah, California and perhaps other states, there are extensive sources of potash for which practical processes of recovery and manufacture can be developed. It finds that with an expenditure of $50,000 annually for 5 years systematic chemical and engineering researches can be conducted in such a way as to bring about definite tests and results.

Complaint Against Soap Company

In a complaint issued by the Federal Trade Commission the T. M. Sayman Products Co., of St. Louis, is charged with using unfair methods of competition in the enforcement of a resale price system. The company is a manufacturer of medicinal preparations, soaps, perfumes and allied products.

The complaint alleges that the respondent secures the support and cooperation of distributors of its products in enforcing the maintenance of its price plan. Various methods alleged to have been used in carrying out such price system are detailed in the citation.

Confusion of Nitrite and Nitrate of Soda

Owing to the fact that the recent increase in import duty on nitrite of soda has been regarded in many quarters as referring to nitrate of soda, the United States Tariff Commission has issued a press notice explanatory of change in duty. This notice states that sodium nitrite and sodium nitrate are two distinct and separate articles. Sodium nitrite differs completely from sodium nitrate, both chemically and in the purposes for which it is used. Sodium nitrite is a chemical employed almost exclusively in the manufacture of coal-tar dyes and is not used as a fertilizer. The increase in the rate of duty on sodium nitrite can have no effect upon the cost of fertilizers. The altogether different article sodium nitrate, sometimes called Chilean saltpeter, is used as a fertilizer. It is on the free list and therefore could not be made dutiable under the flexible provisions of the tariff act. The Executive order of May 6 does not affect sodium nitrate in any way.

Heavy Output of Plate Glass From Belgian Plants

In a report from Belgium, Acting Commercial Attaché S. H. Cross states that the present monthly output of the Belgian plate glass works is: Anvelais, with five furnaces, 65,000 sq.mm. of rough and 50,000 sq.mm. of polished plate; Charleroi, with six furnaces, 61,500 sq.mm. of rough and 42,000 sq.mm. of polished; Floreffe, with three furnaces, 38,000 sq.mm. of rough and 30,000 sq.mm. of polished; Moustier, with five furnaces, 65,000 sq.mm. of rough and 55,000 sq.mm. of polished; Nationales, with seven furnaces, 85,000 sq.mm. of rough and 65,000 sq.mm. of polished; Ste. Marie d'Oignies, 40,000 sq.mm. of rough and 31,000 sq.mm. polished.

The outlook for window glass is less favorable, although there has been no reduction of output thus far. Very little new business is being received, with the result that most plants, after finishing up the orders on hand—which will carry them about to the end of May—will close down to some extent for repairs and to await stabilization of the market.

Synthetic Methyl Alcohol Reported

Reports from Germany to the effect that the Badische company has manufactured methyl alcohol successfully on a commercial scale by a new method is taken seriously in Washington. Because of the difficulties in making payment for raw material originating outside of Germany, there has been great concentration on the problems of producing as many as possible of these raw materials within Germany. As a result of this need it is believed that a workable plan has been evolved for the manufacture of methyl alcohol from carbon monoxide and hydrogen.

Civil Service Examinations

The United States Civil Service Commission announces that applications for the position of assistant explosive technologist will be received up to July 8. Competitors will not be required to report for examination at any place, but will be rated on their education, training and experience, and writings to be filed with the application. Under the classification act of March 4, 1923, the entrance salary for this position in the District of Columbia, beginning July 1, 1924, will be $2,400 a year. Advancement in pay may be made without change in assignment to $3,000 a year. For appointment outside of Washington, D. C., it is possible that this same rate of pay may be applicable after June 30, 1924, but if not, the entrance salary will range from $1,800 to $2,400 a year.

An examination for laboratory aid (physiological and fermentation investigations) will be held July 9. It is to fill a vacancy in the Bureau of Plant Industry, Department of Agriculture, and vacancies in positions requiring similar qualifications, at an entrance salary of $1,320 a year. Advancement in pay may be made without change in assignment to $1,680 a year.

Washington A.C.S. Committee Finds Surplus After Meeting

At the meeting of the Washington Section of the American Chemical Society held on the evening of May 8, the convention committee reported that, owing to the fact that about 800 more attended the meeting than had been expected and paid registration fees, there was a balance of approximately $2,300 in the possession of the committee. This balance was only in part due to the funds which local members had subscribed as hosts to the success of the meeting. Attention was called to the fact that at the suggestion of the Rochester Section the council had approved the appointment of a committee to consider the question of permanent headquarters for the society in Washington, including a building for the housing of the society offices and a possible endowment of the society's activities. As a result it was voted to establish a trust fund of the Chemical Society of Washington to be applicable to the establishment of permanent headquarters for the society in Washington. It was also voted to pay into this trust fund any balance remaining in the hands of the convention committee after each member has had the opportunity, during the interim of 60 days. to withdraw, if he wishes, his contribution to the success of the Washington meeting.

Columbia Dam to Create Northwest Chemical Industry

In connection with a hearing at Seattle to consider the objections of the fish industry to the construction of a 90 ft. dam across the Columbia River at Priest Rapids, Henry J. Pierce, the president of the Washington Irrigation Development Co., revealed that the 400,000 hp. which is to be developed at that point will be used entirely in electrochemical and metallurgical processes. There is no intention of transmitting any of this power to Portland, Seattle or Spokane. One of the main uses of the power will be in the manufacture of ammonia by the Cascale process. In connection with the development the North American rights have been obtained for the use of the Liljenroth process of making phosphoric acid. By that process electric furnaces are used instead of sulphuric acid.

Exports of Chemicals Make Slight Gain in April

Imports Decline Sharply From Totals for March—Both Imports and Exports Below Last Year's Figures

Imports of free list chemicals declined sharply during April. The April total for imports of that character was $6,357,284. The value of March imports of free list chemicals exceeded $9,000,000.

There was a slight increase in the value of the imports of dutiable chemicals. The total for April was $2,970,761, as compared with $2,630,374 for March. The April figures, however, show a decided falling off of imports in dutiable chemicals as compared with April, 1923, when the total was $3,671,323.

There was a decided decline in April in imports of colors, dyes, stains, color acids and color bases. In April, imports totaled 206,986 lb., as compared with 382,921 lb. in March.

April imports of paints, pigments and varnishes increased slightly. Their value was $245,725, as compared with $217,575 in March. Imports in this group were greater by $100,000 than in April, 1923.

Fertilizer Imports Decline

The April figures show a sharp decline in fertilizer imports. The total was 111,815 tons, as compared with 227,341 tons in March. Smaller receipts of sodium nitrate were largely responsible for the loss. April imports of the commodity totaled 73,219 tons, whereas the March figure was 115,119 tons. There also was a slight decline in imports of sulphate of ammonia and in the phosphate and potash groups.

The foregoing figures and those which will follow in this article are those of the Department of Commerce.

The comparative figures covering certain other chemicals are as follows:

	April, 1923	April, 1924
White arsenic, lb.	1,476,066	2,218,339
Citric acid, lb.	84,224	148,848
Formic acid, lb.	144,292	144,283
Oxalic acid, lb.	129,737	190,461
Tartaric acid, lb.	22,400	199,908
Copper sulphate, lb.	.....	709,476
Potassium carbonate, lb.	834,368	652,271
Potassium hydroxide, lb.	941,519	918,849
Potassium chlorate, lb.	.....	563,326
Sodium cyanide, lb.	1,445,643	4,211,314
Sodium ferrocyanide, lb.	100,905	267,692
Sodium nitrite, lb	652,382	842,189
Sodium nitrate, tons	98,577	73,219
Dead or creosote oil, gal.	4,631,534	4,786,394
Naphthalene, lb.	1,789,425	694,084

The exports of chemicals and allied products during April showed a slight increase over March, but still are running about 20 per cent under the volume of the corresponding months of last year. The April total was $9,555,333.

Coal-Tar Group Slumps

In the coal-tar group there was a decided slump. The value of April exports was $475,747, or practically one-half of the value of the exports of coal tar products in March.

There was a slight increase in the volume of exports of sodas and sodium compounds. The March total was 25,047,097 lb.

The exports of pigments, paints and varnishes declined slightly. The April total was $1,176,363. In March the value of the exports exceeded $1,300,000.

There was a decided upturn in the export movement of fertilizer during April. The April total was 93,828 tons, an increase of more than 20,000 tons as compared with March.

The exports in sulphate of ammonia do not contribute to the increase, as there was a slight decline in the export of that commodity. The April total for sulphate of ammonia was 11,173 tons, as compared with 11,325 tons in March. The increase came largely from increased shipment to phosphate rock, although there was a general increase in the export of phosphate materials and of prepared fertilizer mixtures. The movement to other countries of explosives was increased greatly. April exports passed the 2,000,000 lb. mark, an increase of nearly half a million.

Comparative figures covering certain other exports are as follows:

	April, 1923	April, 1924
Benzol, lb.	251,358	12,626
Sulphuric acid, lb.	86,874	53,185
Acetate of lime, lb.	4,448,824	1,420,898
Bleaching powder, lb.	659,335	1,865,051
Potash chlorate, lb.	28,078	18,903
Potash bichromate, lb.	240,678	73,374
Sodium cyanide, lb.	447,773	76,073
Soda ash, lb.	1,812,275	2,132,040
Soda, caustic, lb.	12,284,777	8,044,417

Absorption Symposium Planned at Ithaca in September

At the Washington meeting of the American Chemical Society the executive committee of the Industrial Division decided to hold a symposium dealing with absorption when the society meets in Ithaca, Sept. 8 to 13. The following is a very tentative outline of the proposed program of the symposium.

There will be one or more papers dealing with the mechanism of absorption, two or three papers describing experimental work that confirms the theory as to the mechanism of absorption, a paper showing the application of this theory to commercial installation, three or four papers dealing with commercial absorption equipment, and one or two papers that will emphasize the industrial chemical side of absorption.

Prof. Walter G. Whitman will act as chairman of the symposium. Already he has been able to secure promises from several prominent authorities to present papers before this symposium. The attention of the members of the society is called to the fact that completed papers, not to exceed 3,500 words, must be in the hands of the chairman of the symposium or the secretary of the division on or before Aug. 1. The papers are then submitted to reviewers and only upon their favorable recommendation are the papers placed upon the final program. An abstract not to exceed 200 words should accompany each paper.

Chemists working in any of the many applications of the field of absorption should get in touch with Professor Whitman at their earliest convenience. His address is Massachusetts Institute of Technology, Cambridge, Mass.

News in Brief

M. C. A. to Elect Officers—Election of officers and other business incident to the annual meeting of the Manufacturing Chemists Association will be conducted on June 4 when members of the society meet at the Whitehall Club, 17 Battery Place, New York. Henry Howard, chairman of the executive committee, will read a report giving a detailed account of the organization's work during the past year. Elon H. Hooker, the president of the Manufacturing Chemists Association, will preside.

Elk Tannery to Resume—The Elk Tanning Co., Ridgway, Pa., is perfecting plans for the immediate resumption of operations at its Eagle Valley tannery, following a curtailment for a number of weeks past. The plant will reopen on a basis of about 80 per cent of capacity, with advancement to maximum output as soon as conditions warrant. Employment will be given to close to normal working force.

Rubber Lab in Long Island City—A rubber-compounding and testing shop has been established by the Binney & Smith Co., in Long Island City, N. Y., in connection with its rubber development department. Complete laboratory equipment of modern design has been installed. It is announced that special attention is to be given compounding to develop materials giving high reinforcement.

Stinnes to Make Chemicals in Rumania — A message from Bucharest says that the Chemische Fabriken, which belongs to the Stinnes concern, has installed chemical works at Medes for the manufacture of colophony, sulphuric acid and tannic acid. The firm will grant a credit of 3 months to its customers, which is no longer customary in Rumania since capital became so scarce.

Powell River Project Goes Forward—A contract for the development of the Powell River Pulp & Paper Co., Powell River, B. C., has been let to three Vancouver engineers: W. C. Ditmars, Stuart Cameron and J. S. Connell. The contract price is reported to be over $1,000,000.

American Machinery Operates Chinese Oil Mill—Julean Arnold, commercial attaché at Pekin, states that a company at Foochow, China, is operating a modern oil mill equipped with American machinery. It is at present making peanut oil and crushes about 10 tons a day. This company will experiment to see if it can devise a crushing and refining plant for wood oil.

Goodrich Develops in England—The B. F. Goodrich Rubber Co., New York, is developing its English properties with an investment stated at close to $1,200,000. The company recently acquired the plant of the Ajax Rubber Works, Ltd., Leyland, Lancashire, and has been making extensions and improvements, including the installation of machinery for the production of tires and mechanical rubber goods, at a cost of about $250,000.

Men You Should Know About

BENNETT R. BATES, of the Mexico office of the Dorr Co., left San Francisco for Salt Lake City on May 19, en route to New York. Mr. Bates plans to sail from New York to South Africa, via London, on June 6.

E. B. BENGER has been transferred from the fabrikoid department of the du Pont organization to be chemical director of the du Pont Fibre Silk Co. He assumed his new work in the Buffalo plant on May 1.

Dr. CHARLES A. BROWNE, chief of the Bureau of Chemistry in the Department of Agriculture, was recently initiated into honorary membership in Phi Lambda Upsilon by Gamma Chapter, at Columbia University. Dr. Browne spoke on "The History of Sugar Chemistry in New York City," illustrating his talk with pictures of early sugar houses and their equipment.

M. L. CROSSLEY, of the Calco Chemical Co., Bound Brook, N. J., was elected president of the American Institute of Chemists, and not M. L. Crosby, as given in this column last week.

ROSS CUMMINGS left the employ of the Sperry Flour Co. with the closing of the Vallejo mill and laboratory and has taken a position with Pike & West, consulting chemical engineers in San Francisco.

C. E. FRENCH, representing the Howard Smith Paper Mills, Montreal, recently returned from an extended business trip through South America, Mexico and the West Indies.

Dr. JOEL H. HILDEBRAND addressed the California Section of the American Chemical Society at Berkeley on May 16, and stressed the importance of considering surface phenomena from the chemical standpoint.

PAUL F. HOLSTEIN has resigned from the American Trona Corporation, Searles Lake, Calif., and will sail from Los Angeles for Chile on June 5. His address there will be Oficina Chacabuco, Antofagasta.

W. R. LAYNE has resigned as pump engineer at the Standard Oil Co.'s plant at Richmond, Calif., to become associated with the Byron Jackson Pump Manufacturing Co., Berkeley, Calif., oil pumping division.

W. A. NEILL, head of the mechanical engineering department of the Dorr Co., after June 15 will be located in New York in the executive offices of the company.

Dr. WALTER F. RITTMANN, of the Carnegie Institute of Technology, has been appointed consulting engineer to the State of Pennsylvania.

L. I. SHAW has resigned from the U. S. Bureau of Mines to take a position with the Western Electric Co. He will assume his new work at the Hawthorne plant the early part of June.

P. S. TARBOX has resigned as general manager of the Ohio Valley Refining Co., St. Mary's, W. Va., effective May 31, and in the future will devote his entire time to the Independent Refining Co., Oil City, Pa., of which he has also been general manager for a number of years.

Dr. W. A. TAYLOR has resigned his position as chief of the Organic Department, Chemical Warfare Service, Edgewood Arsenal, Md., to enter the LaMotte Chemical Products Co. as treasurer and chemical director.

At a meeting of the Engineers Club of the Lehigh Valley, at Bethlehem, Pa., May 16, D. M. PETTY, of the Bethlehem Steel Co., was elected president for the ensuing year; JOHN NORVIG, of the New Jersey Zinc Co., Palmerton, Pa., was elected vice-president; and Prof. THOMAS E. BUTTERFIELD, of the Lehigh University faculty, was elected secretary and treasurer.

At the annual meeting of the Natural Gas Association, Cleveland, Ohio, JOHN B. CORRIN, of Pittsburgh, Pa., was elected president for the ensuing year; A. W. LEONARD, of Tulsa, Okla., was elected vice-president; and WILLIAM B. WAY, of Pittsburgh, Pa., secretary and treasurer.

Obituary

W. T. BURT, controller for the Wheeling Steel Corporation, Wheeling, W. Va., was killed instantly in an automobile accident on the National Pike, Washington, Pa., on May 22.

JAMES I. FORD, of Wilmington, Del., well-known leather manufacturer, died at the Delaware Hospital in that city, May 20, following a nervous breakdown. He was 58 years of age and had been engaged in the leather industry for the past 37 years. He was head of the Wilmington Leather Co. in 1919 when the plant was destroyed by fire. Afterward a new company under the name of Ford & Rennie was organized, which continued for only a short time. He is survived by his wife, two sons and four daughters.

JAMES HARTLEY GORDON, secretary-treasurer and a director of the Sherwin-Williams Co., Canada, died in a Montreal hospital after an illness extending over two months.

GEORGE EDWARD LONG, former vice-president and director of the Dixon Crucible Co., Jersey City, N. J., died on May 21 at the residence of his daughter at Ridgewood, N. J., aged 74 years. He entered the employ of the Dixon company as a messenger in 1878, retiring as vice-president in 1920.

Calendar

AMERICAN ASSOCIATION OF CEREAL CHEMISTS, Curtis Hotel, Minneapolis, Minn., June 9 to 14.

AMERICAN CERAMIC SOCIETY, summer meeting and tour, July 21 to Aug. 18.

AMERICAN ENGINEERING STANDARDS COMMITTEE, executive meeting, New York, July 12.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Denver, Colo., July 15 to 18.

AMERICAN LEATHER CHEMISTS ASSOCIATION, Spring Lake, N. J., June 18 to 20.

AMERICAN SOCIETY FOR TESTING MATERIALS, Atlantic City, June 23 to 28.

INSECTICIDE AND DISINFECTANT MANUFACTURERS ASSOCIATION, Montreal, Canada, June 30 to July 1.

MANUFACTURING CHEMISTS ASSOCIATION, annual meeting, India House, New York City, June 4.

NATIONAL FERTILIZER ASSOCIATION, Kenilworth Inn, Asheville, N. C., June 9 to 14.

NEW JERSEY CLAY WORKERS ASSOCIATION AND EASTERN SECTION AMERICAN CERAMIC SOCIETY, summer meeting, Trenton, N. J., June 20.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, Boulder, Colo., June 25 to 26.

WORLD POWER CONFERENCE, London, June 30 to July 12.

Columbia Gives Summer Course to Graduate Chemical Engineers

The Department of Chemical Engineering of Columbia University has announced a graduate course in chemical engineering practice beginning today, June 2, and continuing for 6 weeks. The course is designed to meet the needs of the following:

1. Students who have finished courses in chemical engineering and who desire to acquire experience and training in the methods of chemical engineering practice.

2. Instructors in chemical engineering and chemistry in technical schools, universities and colleges who have not had but who desire a thorough course in the unit operations of chemical manufacture to give the proper perspective for their teaching work.

3. Graduate students in chemistry and chemical engineering who are preparing themselves to assume positions of responsibility in the industries, and who desire to have practical experience in solving live problems in chemical engineering.

The work will be conducted on the squad system, each squad consisting of four men, one of whom will act as foreman.

Brown to Give New Degree

Brown University, Providence, R. I., has arranged for the conferring of a new degree by the institution, beginning next fall, to be known as bachelor of science in chemistry. The change has been brought about through the growing importance of chemistry in the college curriculum. The entrance requirements will be the same as those for the present Ph.B. degree, with the exception that candidates must present two units in algebra. The course is being so planned that the student who completes it and is accorded the degree will be able to take up industrial work in chemistry, to study chemical engineering and to teach and to do graduate work. Many undergraduates are said to have signified their intentions already of changing from the Ph.B. course to the new one.

Financial

At the stockholders' meeting of the Reynolds Spring Co. of Detroit, to be held June 26, will be taken up a proposal to acquire the common stock of the General Leather Co., of Newark, N. J.

The report of the Glidden Co. and subsidiaries for 6 months ended April 30 shows net profits of $446,058, as compared with $445,106 for the corresponding period of 1923.

The International Salt Co. has declared regular quarterly dividend of $1.50, payable July 1.

The report of Casein Co. of America for year ended Dec. 31, 1923, shows net income of $228,632 after depreciation, compared with $407,159 in 1922.

The American Can Co. has declared regular quarterly dividend of 1¾ per cent on preferred stock.

To Discuss Chrome Leather

In spite of the commercial importance of chrome-tanned leather there is still discussion as to the relative merits of chrome and vegetable tanned leathers.

An excellent opportunity for tanners to get further information on this important question is offered by the convention of the American Leather Chemists Association to be held at the Monmouth Hotel, Spring Lake, N. J., June 18 to 20. Dr. Lloyd Balderston will present a paper on "A Comparison of Chrome and Vegetable Tanned Belting Leather"; K. Gustavson will discuss "A New Method for Determination of Degree of Complexity in Chrome Salts"; and A. C. Orthman, of Pfister & Vogel Leather Co., will submit a committee report on the methods for standardizing the analysis of chrome leather.

Trade Notes

The output of chrome ore in Rhodesia in April was 15,608 tons. Arsenic output in the same period was 11 tons.

The Indian Tariff Board has recommended the removal of the 15 per cent ad valorem duty on sulphur imported into British India.

Howard I. Norris, general export and import agent of the Erie Railroad Co., died last week at his home in Newark, N. J.

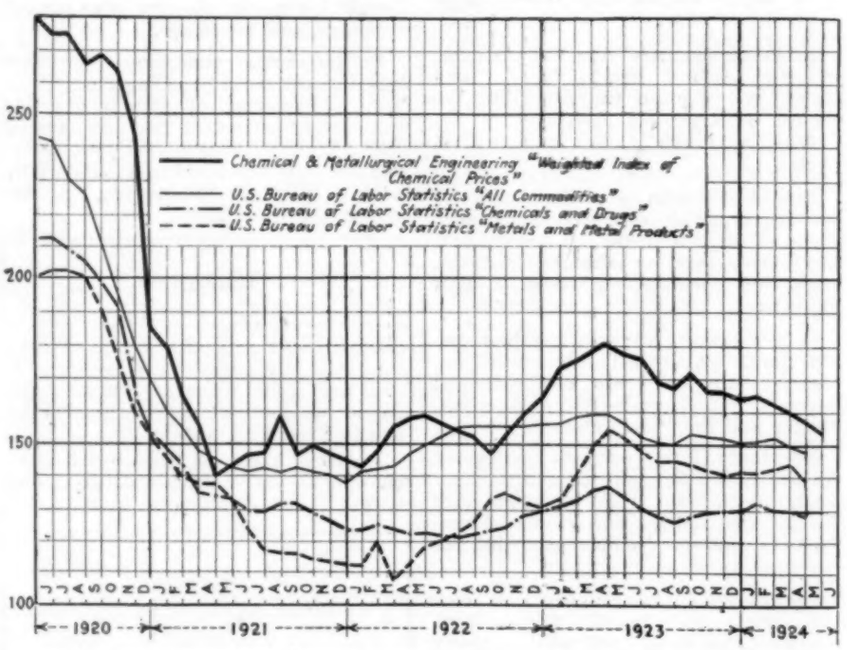
Vice-Consul Julian F. Harrington in a report from Antwerp states that the year 1923 was not a prosperous one for Belgian linseed oil merchants. It was marked by price fluctuations brought about by depreciation of the franc, the serious competition with soya bean oil, and at times insufficient stocks of seeds. The quotation for January, 1923, averaged 294 francs per 100 kilos and at the close of December, 417 francs.

S. W. Russell, of the Mallinckrodt Chemical Works of St. Louis, was a visitor at the local offices of the company last week.

Chemical Prices Declined During May

Slower Buying Movement Aids in Reducing Values—Restricted Outputs Prevent Heavy Accumulations

A quiet call for chemicals and allied products was reported throughout last month. Manufacturing industries, in some cases, were not operating as fully as in April and actual consumption of raw materials was affected accordingly. Some slowing up in contract deliveries of chemicals was noted, but this was more or less seasonal. It is the failure of new buying orders to assume large proportions which has had the greatest influence in curtailing production in recent months. Producers in many lines have been carrying surplus stocks of finished products and have tried to reduce holdings by cutting down present output. Consuming demand has not been heavy enough to absorb these surplus offerings and at the same time permit production to go on unabated.



Prices for chemical products throughout May were unsteady, with private terms entering into many transactions. Revisions in price schedules were almost entirely in buyers' favor. The weighted index number averaged 152.95 for the month, in comparison with 157.85 and 160.55 for April and May respectively. While different causes contributed to the downward movement of values, it was evident that the main influence consisted in the fact that buying had fallen off and the law of supply and demand brought out reductions in prices both for raw materials and for finished products.

Import and export trade in chemicals have been affected by the general policy of retrenchment. Government figures for April trade show a sharp decline in imports, with very little change in exports as compared with the figures for March. Comparison with corresponding months of last year, however, illustrates the marked falling off in both divisions of our foreign trade in chemicals and allied products. It is true that the comparisons on a value basis do not represent similar declines in quantities, but even after allowance has been made for the lower unit prices now prevailing, it is found that the volume of our import and export trade in chemicals is considerably less than a year ago.

Tariff influences were reflected in the commodity markets during the month. On May 6 it was officially announced that the import duty on nitrite of soda had been advanced from 3c. to 4½c. per lb. Later in the period a similar announcement raised the duty on barium dioxide from 4c. to 6c. per lb. Each of these chemicals had been investigated by the U. S. Tariff Commission and the higher duty was imposed in accordance with the flexible provisions of the tariff act. The increase in duty had an immediate effect in increasing the price for nitrite of soda and is expected to result in a larger domestic output.

The U. S. Bureau of Labor in its report on wholesale prices in April stated that the trend continued downward. The weighted index number for 404 commodities was 148, as compared with 150 for March and 159 for April, 1923. Chemicals and drugs were represented by 128 in April and 130 in March. Metals and metal products showed a still greater decline, the weighted numbers being 139 for April and 144 for March.

Trade Commissioner at Buenos Aires Appointed

Announcement was made last Tuesday by Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce, of the appointment of L. B. Clark, of Lynn, Mass., as trade commissioner at Buenos Aires. Mr. Clark has been engaged for some years in business enterprises in South American countries.

Market Conditions

Moderate Buying Continued in Market for Chemical Products

Basic Chemicals Hold at Former Price Levels—Weighted Index Number Shows Very Little Change

THE market for chemicals is drifting along without much change in trading activity from week to week. Main interest is centered in small lots for current needs and forward requirements are given no consideration. Buying orders are distributed among a wide range of selections with no sustained call for any one of the list. The fact that the manufacturing industries have been below normal has had a corresponding effect on materials and this condition is bound to continue for some time.

While market values for chemicals have declined steadily, the same is true of most of the raw materials from which they are made. This has resulted in sacrifices of the finished products but has likewise lowered replacement costs and has given a legitimate aspect to current values. Price changes during the week were not important and the weighted index number closed at 151.24 as compared with 151.26 for the preceding week.

Official figures for exports and imports of chemicals in April were made public during the week. An analysis of the export figures reveals that the amounts shipped abroad in the first 4 months of this year were much below the totals for the corresponding period last year. Hence it becomes evident that the loss in export trade has contributed materially to the slower buying movement of chemicals.

Arsenic, which had been almost in a state of stagnation, received more attention during the week. In addition to spot sales of imported, a good business in domestic arsenic was reported. It is a little early to determine whether this is to mean a resumption of buying, but it has given encouragement to producers and sellers. Reports of weevil damage to the cotton crop so far have been unimportant and with the season backward, it is possible that calcium arsenate will yet find a ready market.

Acids

Official figures of imports in April place arrivals of tartaric acid at 199,908 lb. and citric acid at 148,848 lb. Demand for these acids has been fairly steady and a good part of arrivals has gone direct to consumers. However, offerings on spot are free and prices have been easy. Domestic grades are quoted above selling prices of imported and most of spot trading is in the latter. Oxalic acid likewise has been imported in a large way as is shown by receipts of 190,461 lb. in April. The market price for this acid is unsteady and private terms enter into most sales. Acetic acid is easy in tone with buying moderate and stocks in sellers' hands rather large. Lactic acid has held a fairly normal course with producers reported to be carrying no surplus stocks. Different consuming trades are reported to be buyers of lactic, and this acid is in a relatively good position when compared with most of the other acid groups. Mineral acids are moving regularly on contracts, but new business has been light, and values have not recovered from the weakness brought about by a preponderance of supply over demand.

Lower Prices for Tin Salts—Old Contract Prices for Potash Salts Extended—Arsenic Steadier—Formaldehyde Sells at Concessions—Barium Products Lower — Yellow Prussiate of Potash Firm—Limited Offerings of Nitrate of Soda

Potashes

Bichromate of Potash — Export demand has been slow and outward shipments in April were but 73,374 lb. as against 240,678 lb. in April, last year. Domestic buyers are taking on stocks in a conservative way. Prices have held a fairly steady course but offerings are free at 9¼c. per lb. and in some quarters moderate sized lots can be purchased at that figure.

Caustic Potash—Arrivals of imported caustic have been holding up well, and in April receipts were 918,849 lb., which compares with 941,519 lb. in April, 1923. Asking prices for spot goods are given at 6¾@7c. per lb., with a few lots said to be available at 6¾c. per lb. Cables from foreign markets quoted 6.85c. per lb. as an inside price for shipments. The firm position of primary markets is affecting spot values and many sellers hold that upward revisions are probable.

Chlorate of Potash—New business is reported to be fair. Some consumers are still well covered ahead and foreign chlorate is moving regularly against old contracts. Spot chlorate is quoted at 7c. per lb. for prime goods and shipments are fractionally under that figure. Imports in April were 563,326 lb.

Muriate of Potash—Contract prices for this material have been awaited as the old contracts on muriate, sulphate, kainit, and manure salts had expired. Sellers of these German potash salts have not announced a new contract price but have informed the trade that the former schedule will hold good on shipments through July.

Prussiate of Potash—Many sellers of red prussiate have been reserved recently and were holding out for 38c. per lb. Last week some of these sellers were willing to quote 37@37½c. per lb. It is stated that 35c. per lb. can be done in certain quarters but prices show a range according to seller. Yellow prussiate is holding firm on spot with 18½c. per lb. as an inside price and up to 19c. per lb. asked. Shipments were quoted at 19c. per lb. and the strength shown in foreign markets is expected to be communicated to spot holdings.

Sodas

Acetate of Soda—The market has shown an irregular tendency due to competition among sellers. Consuming call is only moderate and occasionally offerings come on the market under the prices generally quoted. This has been the case in the past few weeks and asking prices of 5@5¼c. per lb. have been subject to shading.

Bichromate of Soda — Offerings of bichromate appear to have become freer and some contract holdings are said to have reached the market due to falling off in consuming needs. Open quotations of 7¼c. per lb. were heard in different quarters and some resale lots were said to have changed hands at private terms.

Caustic Soda — Export shipments in April showed a falling off of more than one-third from the shipments of April, last year. The figures were 8,044,417 lb. and 12,284,777 lb. respectively. There has been no change in the situation and f.a.s. prices are heard from 2.95c. per lb. up to 3.05c. per lb. There were reports that surplus stocks which were offered at low prices were taken from the market by domestic buyers. Buying for domestic account has reflected general industrial conditions but everything considered the movement to domestic consuming plants has been satisfactory. Prices are holding at unchanged levels.

Fluoride of Soda — Offerings have been relatively large and holders have continued to show an eagerness to effect sales. Sellers of domestic are said to have competed in numerous cases although their open prices still

carry a premium over the imported. Prices for the latter are 8¾@9c. per lb. on spot and 8¾c. per lb. for shipments.

Nitrate of Soda—A firm market has ruled for this product with spot holdings very light. Some sellers quote strictly spot delivery as nominal with others quoting $2.60 per 100 lb. Nearby positions also are firm and $2.55 per 100 lb. was the lowest price quoted. Mid-summer deliveries are offered at relatively low prices. Most of present interest is for prompt material and very little inquiry is noted for distant positions. Routine deliveries are reported for refined nitrate, but there are reports that competition from a new source will become a factor and if this is confirmed a decline in consumption would be inevitable.

Nitrite of Soda — High prices are still in effect and the increase in duty has resulted in some sellers of foreign-made nitrite advancing their price to 8¾c. per lb. It is stated that spot material can be purchased at 8¾c. per lb., but 8¾c. per lb. is more general as an inside price. A report has gained circulation in the trade to the effect that consumption of nitrite will gain in volume because of its use in a trade which formerly was not a buyer of nitrite. The accuracy of this report is questioned but factors in the trade hope to have full information very soon. Imports of nitrite in April were large, amounting to 842,189 lb. as compared with 652,382 lb. in April, 1923.

Prussiate of Soda—Only moderate interest is reported in this material. Imported is finding considerable competition from domestic sellers. The latter are said to be taking orders at attractive prices on desirable business. Imported prussiate is quoted at 9¾@10c. per lb. on spot and shipments at 9¼c. per lb. Imports in April were 267,692 lb. as against 100,905 lb. in the corresponding period last year.

Miscellaneous Chemicals

Arsenic — Fundamental conditions in the market have not changed to any extent. With stocks of calcium arsenate large, demand for the latter must improve before buying of arsenic will become active. However, call for arsenic improved during the week. Domestic grades sold at 9c. per lb., and at least one round lot changed hands. Sales of foreign grades were made at prices ranging from 8c. to 8¼c. per lb. Later in the week holders of imported selections were asking 8¾@8¾c. per lb. Japanese arsenic for June shipment from Japan was offered at 8c. per lb. Imports in April are officially given at 2,218,339 lb. as compared with 1,476,066 lb. in April, 1923. Imports for the 10 months ended April were 17,673,148 lb.

Barium Carbonate—Imported grades have been freer and prices have eased off. Holders of spot goods have offered at $61 per ton. The chloride also has been easier and was quoted at $84 per ton.

Copper Sulphate—Sales of imported were made at 4.30c. per lb. in the spot market. Futures were offered at 4¼c. per lb. Domestic is said to have sold freely with prices varying, according to grade, from 4.65c. to 4.90c. per lb.

Formaldehyde — Sellers have been offering freely and the attempt to reduce holdings has weakened values. Carlots were freely offered at 9¼c. per lb. and this price was said to be subject to some shading. Export inquiry has been noted with fairly large lots selling to foreign buyers.

Tin Oxide — Lower prices for the metal combined with keen competition of sellers brought out a sharp break in prices. A decline of 4c. per lb. was announced, thus making the selling price 48c. per lb.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	151.24
Last week	151.26
June, 1923	177.00
June, 1922	157.00
June, 1921	147.00
June, 1920	274.00
June, 1919	229.00
June, 1918	272.00

The weighted index number declined 2 points on slight changes in formaldehyde and other miscellaneous chemical products. Basic chemicals generally were steady.

Alcohol

With no important change in the position of basic materials producers of denatured alcohol take a favorable view of the situation, notwithstanding sales of resale parcels at slight concessions. Shipments against old contracts have been large enough to absorb the bulk of the output. Quotations were repeated on the basis of 45½c. per gal. for the formula No. 1, special denatured, in drums, carload lots.

Methanol was offered freely, and, with stocks ample for current needs, the outlook favored buyers. On the 95 per cent grade 75c. was the general asking price, drums extra, carload basis. Pure methanol, in tank cars, closed at 80c. per gal., works.

Coal-Tar Products

Benzene Stocks Smaller and Market Steadies—Demand for Phenol Less Urgent—Naphthalene Sales Below Normal

REPORTS from the different producing centers indicate that the output of crudes has met with a severe setback. Demand for coke has fallen off and this has resulted in general curtailment in coke oven operations. Stocks of benzene are rather light and the market has developed a firmer undertone, although no open change in the selling schedule has taken place. The fact that gasoline is available at concessions in various sections of the country tends to check talk of a higher market for the coal-tar product. Buying interest in phenol for immediate delivery was not so much in evidence and the market was unsettled at the close. Traders in refined naphthalene are disappointed because of the lack of demand. The unseasonable weather has discouraged buying on the part of consumers. The call for crude naphthalene from makers of intermediates also has been slow. Pyridine continues in limited supply and prices are holding firm. Cresylic acid quotations covered a wide range, competition being keen. Several shipments of coal-tar distillate arrived here during the week from English ports.

Aniline Oil and Salt — First hands held out for 16c. per lb. on aniline oil, in drums, carload basis, prompt and nearby shipment from works. Aniline oil for red was nominal in price at 40c. per lb. Aniline salt barely steady at 22@23c. per lb.

Benzene — Production of byproduct coke during the past month has fallen off to such an extent that the market for benzene has been strengthened considerably. It is reported that some of the smaller factors experienced difficulty in taking care of contract orders. However, prices underwent no quotable change. First hands maintained the selling basis at 23c. per gal. for the 90 per cent grade, and 25c. per gal. for the pure, tank cars, f.o.b. works. Exports of benzene for the month of April, according to official reports, amounted to 12,626 lb., which compares with 251,358 lb. in April a year ago.

Creosote Oil—Domestic production is sold up and the market remains in a nominal state as regards prices. Offerings from abroad have been larger. According to official information the imports of creosote oil in April amounted to 4,786,394 gal., which compares with 4,631,534 gal. in April a year ago.

Cresylic Acid—The market was unsettled, prices being under pressure in some quarters of the trade. The 95 per cent grade was offered at 60@65c. per gal., with the 97 per cent material at 65@70c. per gal., prompt and nearby delivery.

H Acid — Demand was inactive, but prices held fairly steady at 72@76c. per lb., according to seller.

Naphthalene — Weather conditions operated against the market for refined naphthalene, and, with offerings large, prices presented an unsettled appearance. Refined flake was available on spot at 5@5¼c. per lb., with ball at 6@6¼c. per lb. On contract these prices could have been shaded. The offerings of crude for shipment from abroad were plentiful at irregular prices.

Phenol—Demand for U.S.P. phenol for immediate delivery was less active, which took some of the edge off the market. Spot material sold at prices ranging from 26@27½c. per lb., in drums, the inside figure obtaining on direct sales between "regular" buyers and producers. Nearby material was offered in more than one direction at 26c. per lb.

Solvent Naphtha—Demand moderate, but with stocks small prices were firmly maintained on the basis of 25c. per gal. on the water white, tank cars, f.o.b. point of production.

Vegetable Oils and Fats

Crude Cottonseed Oil Steady on Moderate Offerings—Coconut Oil Lower—Heavy Imports of Whale Oil

THE volume of business placed in the market for vegetable oils was disappointing. While no important price changes occurred, the tendency, in most instances, favored buyers. A feature was the continued weakness in lard, which had a very depressing influence on cottonseed oil. Coconut oil was available in a large way for future delivery at lower prices. Linseed oil sold for July delivery at concessions. City tallow was barely steady on sales of "outside" brands at a discount. Fish oils were dull and easier prices were named. In the past week 2 cargoes of crude whale oil arrived at New York, this material going directly into consumption.

Cottonseed Oil—Early in the week prices for refined oil in the option market on the Produce Exchange moved into new low ground. But the speculative market was such a narrow affair that net changes for the week were rather insignificant. The undertone, in the main, was easy, reflecting continued weakness in pure lard. On Wednesday cash lard in the Chicago market settled at 10.15c. per lb., while prime summer yellow cottonseed oil closed at 9.50c. bid and 9.75c. asked. Lard compound, which competes directly with pure lard, held around 11½c. per lb., carload basis, New York. Reports on the condition of cash trade in oil were mixed, yet authorities now believe that distribution in May will approximate 150,000 bbl., which compares with 128,500 bbl. in May a year ago. The weather in the cotton belt was not so favorable and private reports on the condition of the crop were below last year's estimates. Because of the unseasonable weather holders of old crop crude oil were not free sellers. Crude oil did sell down to 7.75c. per lb., tank cars, Texas, on the recent break in the market, but late last week bids at 7.87½c. were turned down. In the Southeast 8c. was the nominal quotation for crude oil, in tanks, f.o.b. mills. Inquiry was reported for bleachable oil for July shipment, with offerings scanty.

Linseed Oil — Paint manufacturers took on a little July oil at 90c. per gal., carload lots, cooperage basis. Additional offerings came out at this figure, indicating that the situation has eased somewhat in the nearby positions. Spot oil held at 94c. per gal., carload lots moving at this figure. Several crushers restricted business in spot and early June oil to less than carload lots. Arrivals of Argentine flaxseed have been larger, but crushers have not yet reached the point where they could accumulate any stocks of oil. With new business rather slow it now looks as if the supply situation may improve within the next month. According to crushers enough flaxseed has not been contracted for in the Argentine to build up a large surplus here. Shipments of flaxseed from the Argentine for the period beginning with Jan. 1 and ending May 23 amounted to 33,102,000 bu., which compares with 30,856,000 bu. for the corresponding period a year ago. The fact that shipments are not very much larger than a year ago gives some standing to private reports that the crop may not provide for an exportable surplus of more than 51,000,000 bu. The Buenos Aires market held steady all week, the June option selling around $1.62 per bu. At Duluth the May option settled at $2.46⅞. Receipts in the Northwest have been light and there has been a good demand from crushers. Receipts of seed at Minneapolis and Duluth since the beginning of the crop year have reached the total of 14,450,000 bu. Linseed cake for export was nominal at $33 per ton, f.a.s. New York.

Copra Imports for 9 Months Larger Than Year Ago

Imports of copra for the 9 months ended March 31 show a gain of 24,225,706 lb., compared with the corresponding period a year ago. Imports of oil seeds for the 9 months period, for the past 2 years, follow:

	1924	1923
Cottonseed, lb.	83,227,046	*55,398,820
Castorseed, lb.	51,789,423	52,303,489
Copra, lb.	239,872,114	215,646,408
Flaxseed, bu.:		
Canada	2,311,842	1,761,246
Argentina	9,089,698	12,061,555
Other countries	41,900	441,660
Total	11,443,440	14,264,461

* Beginning Sept. 22, 1922.

China Wood Oil—There were sellers on the Pacific coast at 12½c. per lb., tank cars, nearby delivery. The market here was unsettled on sales of distressed lots, business passing at prices ranging from 13⅞@14½c. per lb., cooperage basis. Demand from varnish makers was quiet.

Soya Bean Oil—Bulk oil was unchanged at 7c. per lb., in bond, c.i.f. Pacific coast ports, May-June-July shipment from the Orient. Nearby oil in tank cars, duty paid, held at 9¾c. coast. Trading inactive.

Coconut Oil — Offerings at lower prices failed to attract buyers. Manila oil was available at 7⅝c. per lb., in bulk, c.i.f. Pacific coast ports, and at 7⅝c. per lb., in bulk, c.i.f. New York, forward delivery. Ceylon type oil, tank cars, nearby positions, held at 7⅜c. asked, f.o.b. Pacific coast shipping centers. Manila copra was offered at 5c. per lb., c.i.f. New York.

Corn Oil—Crude corn oil sold at 8¼c. per lb., tank cars, f.o.b. point of production in the Middle West.

Palm Oil—Lagos palm oil ex-dock was offered at 7¼c. per lb. On shipments from Africa the market for Lagos was nominal at 7c. per lb., c.i.f. New York. Niger on spot steadied, closing at 6⅞c. per lb.; on futures 6⅝c. was regarded as inside. Trading slow.

Olive Oil Foots—Prime green foots sold recently for June-July-August shipment from Italy at 9¼c. per lb. Bids for round lots at 9c. were turned down.

Fish Oils—Refined menhaden oil was dull and easy, scattered lots selling at concessions. Crude was nominal at 47½c., tank cars, factory, summer delivery. English cod oil was offered for forward delivery at 51c. per gal.

Tallow, Etc.—The market was unsettled. Several cars of "outside" tallow, equal to city extra special in quality, sold at 6¾c., ex-plant, equal to 7c. delivered. Extra special held nominally at 7c. per lb., ex-plant. Oleo stearine sold at 10c. per lb., a decline of ¼c. No. 1 oleo oil was lowered to 12½c. per lb.

Miscellaneous Materials

Antimony—Demand was quiet, which offset the recent advance in primary markets, and closing prices were slightly lower than a week ago. Chinese antimony was offered on spot at 8½c. per lb. Cookson's "C" grade was lowered to 12½c. per lb. Chinese needle, lump, nominal at 8½@9c. per lb.

Blanc Fixe—First hands offered carload lots of the dry, in bbl., at 3½c. per lb., prompt shipment from works. Demand fair and market steady.

Diatomaceous Earth—California producers quote $30 per ton f.o.b. plant on the powder for insulation. Natural nominal at $20 per ton, with the calcined at $50 per ton. Filtration powder $30 per ton.

Glycerine—Dynamite glycerine sold in a fairly large way at 15½@15¾c. per lb., carload lots, f.o.b. point of production, the top price obtaining in Eastern territory. C. P. glycerine was steady at 16½@17c. per lb., carload basis, in drums, f.o.b. New York. Soap lye crude, basis 80 per cent, settled at 10½@10¾c. per lb., loose, carload lots, f.o.b. point of production. Offerings of crude were moderate and market closed steady.

Naval Stores—Receipts at Southern points were larger and with no improvement in demand prices eased off. Spirits of turpentine settled at 88c. per gal., a decline of 2c. for the week. In rosins the market was barely steady, but no important price changes took place. On the lower grades sellers quote $5.60@$5.70 per bbl.

White Lead, Etc.—Another reduction in the "official" selling price of pig lead took place, the leading interest lowering the quotation to 7c. per lb., a decline of ¼c. Early in the past week outside sellers offered the metal down to 6.85c., but towards the close the undertone seemed to steady. Corroders reported good shipments of lead pigments against existing contracts. New business, however, did not come up to expectations. The price for standard dry white lead was maintained at 10½c. per lb., in casks.

Zinc Oxide—The market for zinc was irregular, but net changes for the week were insignificant. There was no change in the attitude of sellers of zinc oxide, prices holding on the carload basis of 7⅞c. per lb. for the American process, lead free. Demand for oxide was inactive and the undertone in several quarters barely steady.

Imports at the Port of New York

May 23 to May 29.

ACIDS—Cresylic—12 dr., Liverpool, E. H. Watson. **Citric**—200 bbl., Genoa, Superfos Co.

ALCOHOL—200 bbl., Arecibo, C. Esteva; 1 csk. butyl, Hamburg, Roessler & Hasslacher Chemical Co.

ANTIMONY REGULUS—500 cs., Shanghai, Wah Chang Trading Co.

ARSENIC—20 csk., London, Phoenix Shipping Co.; 10 kegs, London, L. H. Butcher & Co.; 64 csk., Hamburg, Order; 172 bbl., Tampico, American Metal Co.

BARIUM CARBONATE—500 bg., Hamburg, E. Suter & Co.

BARIUM CHLORIDE—113 csk., Rotterdam, T. Goldschmidt Corp.; 52 csk., Hamburg, A. Klipstein & Co.; 102 csk., Hamburg, Brown Bros. & Co.; 52 csk., Hamburg, Order; 60 csk., Bremen, Globe Shipping Co.

BARIUM PEROXIDE—320 dr., London, Order; 76 bbl., Hamburg, W. A. Brown & Co.

BARIUM HYDRATE—14 csk., London, Order.

BARYTES—300 bg., Hamburg, Roessler & Hasslacher Chemical Co.; 25 csk., Hamburg, A. Hurst & Co.

BORACITE—1,000 tons, Panderma, Pacific Coast Borax Co.

BISMUTH—8 cs. metal, Southampton, Order.

CAMPHOR—100 cs. crude, Shanghai, Hetherman & Co.; 5 bbl., Hamburg, Order.

CASEIN—2,083 bg., Buenos Aires, Kalbfleisch Corp.; 102 bg., Hamburg, Order.

CHALK—756 bg., 167 bbl., Antwerp, L. A. Salomon & Bros.; 860 bg. and 100 bbl., Antwerp, Bankers Trust Co.; 240 bg., Antwerp, Bankers Trust Co.; 500 tons, London, Baring Bros. & Co.

COLORS—47 csk. earth, Antwerp, Order; 8 csk. aniline, Rotterdam, Garfield Aniline Works; 3 csk. aniline, Antwerp, Geigy Co.; 20 csk. do., Antwerp, American Exchange National Bank; 25 csk. do., Antwerp, Order; 5 csk. aniline, Genoa, Irving Bank-Col. Trust Co.; 13 pkg. do., Genoa, Order; 25 csk. dry, Hamburg, C. Hellmuth, Inc.; 8 pkg. aniline, Hamburg, H. A. Metz & Co.; 6 csk. do., Hamburg, Kuttroff, Pickhardt & Co.; 9 csk. do., Hamburg, Franklin Import & Export Co.

COPPER OXIDE—25 dr., Hamburg, Order; 30 dr., Hamburg, Order.

COPPER SULPHATE—80 dr., Hamburg, Order.

CHEMICALS—200 csk., Marseilles, Pomeroy & Fischer; 15 pkg., London, Order; 20 pkg., Hamburg, Draeger Shipping Co.; 72 pkg., Hamburg, Pfaltz & Bauer; 336 bg., Glasgow, Brown Bros. & Co.

COAL-TAR DISTILLATE—13 dr., Liverpool, Monsanto Chemical Works; 138 dr., Liverpool, W. Foster; 49 dr., Liverpool, Order; 58 dr., Glasgow, Order.

FLUORSPAR—1,062,888 lb., Cape Town, Standard Bank of South America; 334 bg., Hamburg, Roessler & Hasslacher Chemical Co.

FULLERS EARTH—250 bg., London, C. B. Chrystal Co.

GALLNUTS—300 cs., Hankow, Mallinckrodt Chemical Works.

GLYCERINE—150 dr. crude, Marseilles, Order.

GLAUBER SALT—750 bg., Hamburg, E. Suter & Co.; 276 csk., Hamburg, E. Suter & Co.

GUMS—420 bg. copal, Antwerp, W. Schall & Co.; 310 bg. do., Antwerp, Order; 200 cs. and 321 bg. damar, Singapore, Brown Bros. & Co.; 186 bg. copal, Matadi, Niger Co.; 500 cs. damar, Batavia, Chemical National Bank; 150 cs. do., Batavia, Irving Bank-Col Trust Co.; 200 cs. do., Batavia, Bank of the Manhattan Co.; 300 cs. do., Batavia, Catz American Co.; 200 cs. do., Batavia, Order; 50 cs. do., Singapore, Chemical National Bank; 128 bg. do., Singapore, L. C. Gillespie & Sons; 128 bg. do., Singapore, Brown Bros. & Co.; 102 bg. copal, Antwerp, Chemical National Bank.

IRON OXIDE—279 bbl., Malaga, A. E. Rittwagen; 330 bbl., Malaga, Reichard-Coulston, Inc.; 86 bbl., Malaga, E. M. & F. Waldo; 274 bbl., Malaga, C. J. Osborn & Co.; 544 bbl., Malaga, C. K. Williams & Co.; 266 bbl., Malaga, Order; 188 bbl., Malaga, C. J. Osborn & Co.; 125 bbl., Malaga, C. K. Williams & Co.; 30 bbl., Malaga, Order.

KAOLIN—400 bbl., Hamburg, Roessler & Hasslacher Chemical Co.

LAMPBLACK—7 csk., Antwerp, Order.

LITHOPONE—50 csk., Antwerp, E. M. & F. Waldo, Inc.; 60 bbl., Hamburg, Order.

MAGNESIUM CHLORIDE—519 dr., Hamburg, Order; 344 bbl., Hamburg, Innis, Speiden & Co.; 183 dr., Hamburg, Brown Bros. & Co.; 364 dr., Hamburg, Order; 180 dr., Hamburg, Brown Bros. & Co.; 93 bbl., Hamburg, Roessler & Hasslacher Chemical Co.; 444 dr., Hamburg, Order.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

CAUSTIC SODA, soda ash, bicarbonate, and copper sulphate. Lima, Peru. Agency.—10,333.

FERTILIZER, basic slag. Wellington, New Zealand. Purchase.—10,341.

INSECTICIDES AND FUNGICIDES. Warsaw, Poland. Purchase.—10,366.

PAINTS. Khartum, Africa. Agency.—10,363.

ROSIN. Valparaiso, Chile. Agency.—10,275.

ROSIN AND TURPENTINE. Lima, Peru. Agency.—10,333.

VARNISH STAINS, materials for; and wax. Zagreb, Yugoslavia. Purchase.—10,359.

TAR AND TAR PRODUCTS for roads. Durban, South Africa. Agency.—10,301.

LINSEED CAKE. Amsterdam, Netherlands. Purchase and agency.—10,284.

PARAFFINE WAX. Lima, Peru. Agency.—10,333.

MAGNESIUM CARBONATE—272 bg., Hull, Order.

MANGANESE ORE—3,969 tons (in bulk), Secondee, Lavino Shipping Co.

MANGROVE BARK—500 bg. extract, Singapore, Order.

NAPHTHALENE—35 csk. flake, Hull, Order.

OCHER—348 csk., Marseilles, Reichard-Coulston, Inc.; 100 bbl., Malaga, Hummel & Robinson Co.

OILS—Cod—200 bbl., Hull, Order. **Cocoanut**—828 tons (in bulk), Cebu, Philippine Refining Co. **Linseed**—60 bbl., Rotterdam, Order. **Olive Foots** (sulphur oil)—260 bbl., Sevilla, Order; 100 csk., Leghorn, Leghorn Trading Co. **Palm**—530 dr. and 44 csk., Matadi, Niger Co.; 33 csk., Port Harcourt, African & Eastern Trading Co.; 480 csk., Port Harcourt, Niger Co.; 1,951 csk., Buruti, Irving Bank-Col. Trust Co.; 646 csk., Koko, Niger Co.; 69 csk., Lagos, J. Walden & Co.; 158 csk., Lagos, Niger Co.; 233 csk., Hamburg, African & Eastern Trading Co. **Rapeseed**—317 bbl., Hull, Order; 200 bbl., Hull, Vacuum Oil Co.; 400 bbl., Hull, J. C. Francesconi & Co.; 150 bbl., Hull, Balfour, Williamson & Co. **Sod**—20 bbl., Liverpool, R. Badcock & Co. **Sesame**—100 bbl., Rotterdam, Welch, Holme & Clark Co. **Whale**—27,021 bbl., Montevideo, Procter & Gamble Co.

OIL SEEDS—Copra—968 bg., Trinidad, Order. **Linseed**—14,324 bg., Buenos Aires, Bingham & Co.; 9,466 bg., Buenos Aires, L. Dreyfus & Co.; 18,268 bg., Buenos Aires, L. Dreyfus & Co.; 26,073 bg., Buenos Aires, L. Dreyfus & Co. **Peanuts**—625 bg., Tientsin, D. H. Bain & Co.; 1102 bg., Shanghai, Wah Chang Trading Co.

PITCH—108 bbl., Genoa, Imperial Bank of Canada.

POTASSIUM SALTS—100 csk., bicarbonate, Rotterdam, Brown Bros. & Co.; 4 csk. prussiate, Rotterdam, Order; 300 csk. chlorate, Hamburg, E. Suter & Co.; 68 csk. caustic, Hamburg, Goldschmidt Corp.; 170 dr. do., Hamburg, International Acceptance Bank; 100 bbl. chlorate, Hamburg, Brown Bros. & Co.; 35 dr. caustic, Hamburg, American Exchange National Bank; 18 csk. do., Hamburg, A. Klipstein & Co.; 250 bbl. alum., Hamburg, E. Suter & Co.; 100 csk. alum., Hamburg, Order; 1,016 bg. nitrate, Hamburg, Order; 62 bbl. hydrate, Hamburg, Brown Bros. & Co.; 101 dr. caustic and 90 bbl. sulphate, etc., Hamburg, Roessler & Hasslacher Chemical Co.

PYRIDINE—26 dr., Hamburg, E. Suter & Co.; 18 csk., Hamburg, F. W. Kurtz & Co.

QUICKSILVER—150 flasks, Genoa, Order; 17 flasks, Tampica, G. Ramos; 52 flasks, Tampico, Order.

QUEBRACHO—2,274 pcs., Buenos Aires, Tannin Corp.; 14,734 pcs., Santa Fe, Tannin Corp.; 5,559 bg., Buenos Aires, Order; 1,024 bg., Buenos Aires, National Bank of Commerce.

SAL AMMONIAC—55 csk., Hamburg, Seaboard National Bank; 20 csk., Hamburg, Order; 156 bbl., Hamburg, Roessler & Hasslacher Chemical Co.; 83 csk., Hamburg, Order.

SHELLAC—21 cs., Bangkok, Keller & Christensen; 100 bg., London, Ralli Bros.; 65 bg. garnet, Hamburg, Irving Bank-Col. Trust Co.; 32 bg. garnet, Hamburg, Irving Bank-Col. Trust Co.; 75 bg., Hamburg, Ralli Bros.

SODIUM SALTS—24 csk. prussiate, Rotterdam, Meteor Products Co.; 15 csk. do., Rotterdam, H. Kohnstamm & Co.; 27 csk., Rotterdam, Order; 100 csk. nitrite, Hamburg, Order; 100 bbl. nitrite, Hamburg, E. Suter & Co.; 15 csk. fluoride, Hamburg, A. Klipstein & Co.; 37 dr. sulphite, Hamburg, C. S. Grant & Co.; 830 cs. cyanide, Hamburg, Roessler & Hasslacher Chemical Co.; 200 keg hyposulphite, Hamburg, Order; 114 csk. nitrate, Hamburg, Order.

TETRACHLORATHENE—80 dr., Hamburg, Roessler & Hasslacher Chemical Co.

TALC—120 bg., Marseilles, J. Mitchell; 250 bg., Genoa, L. A. Salomon & Bros.; 500 bg., Genoa, Coty, Inc.; 1,550 bg., Genoa, Order; 300 bg., Genoa, C. Mathieu; 200 bg., Genoa, Order.

TARTAR—224 bg., Alicante, Harshaw, Fuller & Goodwin; 105 bg., Marseilles, C. Pfizer & Co.; 101 bg., Rotterdam, C. Pfizer & Co.; 446 bg., Alicante, Tarter Chemical Works.

TUNGSTEN—100 cs., Hamburg, National City Bank.

UMBER—280 bg. raw, Larnaca, J. Lee Smith & Co.; 1,729 bg. burnt, Larnaca, Reichard-Coulston, Inc.

VALONEA—719 bg., Smyrna, Order; 11,600 bg. mixture and 1,490 bg. beard, Chanak, J. A. Barkey & Co.; 733 bg. mixture, Chanak, Order.

WAXES—25 bg. beeswax, Havana, Order; 300 cs. vegetable, Kobe, National City Bank; 8 bbl. beeswax, Arroyo, D. Steengrafe; 487 blocks beeswax, Lisbon, Irving Bank-Col. Trust Co.; 14 bbl. beeswax, Rio de Janeiro, D. Steengrafe; 40 bg. carnauba, Rio de Janeiro, Order; 27 bg. beeswax, London, Order; 25 bg. mineral, Hamburg, L. S. Tainter; 99 bg. beeswax, London, Equitable Trust Co.; 2,800 bg. paraffine, London, Asiatic Petroleum Co.

WOOL GREASE—50 cs., Antwerp, Borne, Scrymser Co.; 130 csk., Bremen, Pfaltz & Bauer; 80 bbl., Bremen, W. Schall & Co.

ZINC OXIDE—50 bbl., Marseilles, Reichard-Coulston, Inc.; 50 bbl., Antwerp, Reichard-Coulston, Inc.; 10 csk., Hamburg, Order.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetone, drums, wks.	lb.	$0.15 -	$0.15½
Acetic anhydride, 85%, dr.	lb.	.38 -	....
Acid, acetic, 28%, bbl.	100 lb.	3.12 -	3.37
Acetic, 56%, bbl.	100 lb.	5.85 -	6.10
Acetic, 80%, bbl.	100 lb.	8.19 -	8.44
Glacial, 99½%, bbl.	100 lb.	11.01 -	11.51
Boric, bbl.	lb.	.09 -	.09½
Citric, kegs	lb.	.47 -	.48
Formic, 85%	lb.	.12½-	.13
Gallic, tech.	lb.	.45 -	.50
Hydrofluoric, 52%, carboys	lb.	.11 -	.12
Lactic, 44%, tech., light, bbl.	lb.	.12½-	.13
22% tech., light, bbl.	lb.	.06 -	.06½
Muriatic, 18° tanks	100 lb.	.80 -	.85
Muriatic, 20°, tanks	100 lb.	.95 -	1.00
Nitric, 36°, carboys	lb.	.04 -	.04½
Nitric, 42°, carboys	lb.	.04½-	.05¼
Oleum, 20%, tanks	ton	16.00 -	17.00
Oxalic, crystals, bbl.	lb.	.09½-	.10
Phosphoric, 50% carboys	lb.	.07 -	.08
Pyrogallic, resublimed	lb.	1.55 -	1.60
Sulphuric, 60°, tanks	ton	9.00 -	10.00
Sulphuric, 60°, drums	ton	13.00 -	14.00
Sulphuric, 66°, tanks	ton	14.00 -	15.00
Sulphuric, 66° drums	ton	18.00 -	19.00
Tannic, U.S.P., bbl.	lb.	.65 -	.70
Tannic, tech., bbl.	lb.	.45 -	.50
Tartaric, imp., powd., bbl.	lb.	.27 -	.28
Tartaric, domestic, bbl.	lb.	.30 -	....
Tungstic, per lb.	lb.	1.20 -	1.25
Alcohol, butyl, drums, f.o.b. works	lb.	.25 -	.30
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.83 -	....
Ethyl, 190 p'f. U.S.P., bbl.	gal.	4.81 -	....
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No. 1, special bbl.	gal.	.51½-	....
No. 1, 190 proof, special, dr.	gal.	.45½-	....
No. 1, 188 proof, bbl.	gal.	.52½-	....
No. 1, 188 proof, dr.	gal.	.48½-	....
No. 5, 188 proof, bbl.	gal.	.50½-	....
No. 5, 188 proof, dr.	gal.	.44½-	....
Alum, ammonia, lump, bbl.	lb.	.03½-	.04
Potash, lump, bbl.	lb.	.02½-	.03½
Chrome, lump, potash, bbl.	lb.	.05½-	.06
Aluminum sulphate, com., bags	100 lb.	1.35 -	1.40
Iron free bags	lb.	2.35 -	2.45
Aqua ammonia, 26°, drums	lb.	.06½-	.06¾
Ammonia, anhydrous, cyl.	lb.	.28 -	.30
Ammonium carbonate, powd. tech., casks	lb.	.12 -	.13
Ammonium nitrate, tech., casks	lb.	.09 -	.10
Amyl acetate tech., drums	gal.	3.00 -	3.25
Antimony oxide, white, bbl.	lb.	.09½-	.09¾
Arsenic, white, powd., bbl.	lb.	.08½-	.09
Arsenic, red, powd., kegs	lb.	.14½-	.15½
Barium carbonate, bbl.	ton	61.00 -	66.00
Barium chloride, bbl.	ton	84.00 -	88.00
Barium dioxide, 88%, drums	lb.	.17½-	.18
Barium nitrate, casks	lb.	.08 -	.08½
Blanc fixe, dry, bbl.	lb.	.03½-	.04
Bleaching powder, f.o.b. wks., drums	100 lb.	1.90 -	....
Spot N. Y. drums	100 lb.	2.25 -	2.35
Borax, bbl.	lb.	.05 -	.05½
Bromine, cases	lb.	.28 -	.30
Calcium acetate, bags	100 lb.	3.00 -	3.05
Calcium arsenate, dr.	lb.	.10 -	.10½
Calcium carbide, drums	lb.	.05 -	.05½
Calcium chloride, fused, dr. wks.	ton	21.00 -	....
Gran. drums works	ton	27.00 -	....
Calcium phosphate, mono, bbl.	lb.	.06½-	.07½
Camphor, Jap. cases	lb.	.72½-	.73½
Carbon bisulphide, drums	lb.	.06 -	.06½
Carbon tetrachloride, drums	lb.	.07 -	.07½
Chalk, precip.—domestic, light, bbl.	lb.	.04½-	.04½
Domestic, heavy, bbl.	lb.	.03½-	.04
Imported, light, bbl.	lb.	.04½-	.05
Chlorine, liquid, tanks, wks.	lb.	.04½-	....
Contract, tanks, wks.	lb.	.04½-	....
Cylinders, 100 lb., wks.	lb.	.05½-	.07½
Chloroform, tech., drums	lb.	.30 -	.32
Cobalt, oxide, bbl.	lb.	2.10 -	2.25
Copperas, bulk, f.o.b. wks.	ton	16.00 -	18.00
Copper carbonate, bbl.	lb.	.16½-	.16¾
Copper cyanide, drums	lb.	.45 -	.46
Copper sulphate, dom., bbl.	100 lb.	4.65 -	4.80
Imp bbl.	100 lb.	4.30 -	4.50
Cream of tartar, bbl.	lb.	.20½-	.21
Epsom salt, dom., tech., bbl.	100 lb.	1.75 -	2.00
Epsom salt, imp., tech., bags	100 lb.	1.15 -	1.25
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.10 -	2.35
Ether, U.S.P., dr.	lb.	.14 -	.15
Ethyl acetate, 85%, drums	gal.	.92 -	.95
Ethyl acetate, 99%, dr.	gal.	$1.08 -	$1.10
Formaldehyde, 40%, bbl.	lb.	.09½-	.09¾
Fullers earth—f.o.b. mines	ton	7.50 -	18.00
Furfural, works, bbl.	lb.	.25 -	....
Fusel oil, ref., drums	gal.	3.50 -	4.00
Fusel oil, crude, drums	gal.	2.50 -	2.75
Glaubers salt, wks., bags	100 lb.	1.20 -	1.40
Glaubers salt, imp., bags	100 lb.	.90 -	.95
Glycerine, c.p., drums extra	lb.	.16½-	.16¾
Glycerine, dynamite, drums	lb.	.15½-	.15¾
Glycerine, crude 80%, loose	lb.	.10½-	.10¾
Hexamethylene, drums	lb.	.65 -	.75
Lead:			
White, basic carbonate, dry, casks	lb.	.10½-	....
White, basic sulphate, casks	lb.	.09½-	....
White, in oil, kegs	lb.	.12½-	....
Red, dry, casks	lb.	.12 -	....
Red, in oil, kegs	lb.	.13½-	....
Lead acetate, white crys., bbl.	lb.	.14½-	....
Brown, broken, casks	lb.	.13½-	....
Lead arsenate, powd., bbl.	lb.	.16 -	.18
Lime-Hydrated, bg. wks.	ton	10.50 -	12.50
Bbl., wks.	ton	18.00 -	19.00
Lime, Lump, bbl.	280 lb.	3.63 -	3.65
Litharge, comm., casks	lb.	.11½-	....
Lithopone, bags	lb.	.06½-	.06¾
Magnesium carb., tech., bags	lb.	.08½-	.08¾
Methanol, 95%, bbl.	gal.	.80 -	....
Methanol, 97%, bbl.	gal.	.82 -	....
Methanol, pure, tanks	gal.	.80 -	....
drums	gal.	.82 -	....
bbl.	gal.	.87 -	....
Methyl-acetone, t'ks.	gal.	.75 -	....
Nickel salt, double, bbl.	lb.	.09½-	.10½
Nickel salts, single, bbl.	lb.	.10 -	.11
Orange mineral, csk	lb.	.14½-	.15½
Phosgene	lb.	.60 -	.75
Phosphorus, red, cases	lb.	.70 -	.75
Phosphorus, yellow, cases	lb.	.35 -	.40
Potassium bichromate, casks	lb.	.09½-	.09¾
Potassium bromide, gran., bbl.	lb.	.20 -	.32
Potassium carbonate, 80-85%, calcined, casks	lb.	.05½-	.05¾
Potassium chlorate, powd.	lb.	.07½-	.08¼
Potassium cyanide, drums	lb.	.47 -	.52
Potassium, first sorts, cask	lb.	.07½-	.08
Potassium hydroxide (caustic potash) drums	lb.	.06½-	.07
Potassium iodide, cases	lb.	3.65 -	3.75
Potassium nitrate, bbl.	lb.	.06 -	.07½
Potassium permanganate, drums	lb.	.14½-	.14¾
Potassium prussiate, red, casks	lb.	.35 -	.38
Potassium prussiate, yellow, casks	lb.	.18½-	.19
Salammoniac, white, gran., casks, imported	lb.	.06½ -	.06¾
Salammoniac, white, gran., bbl., domestic	lb.	.07½-	.07¾
Gray, gran., casks	lb.	.08 -	.09
Salsoda, bbl.	100 lb.	1.20	1.40
Salt cake (bulk) works	ton	18.00 -	20.00
Soda ash, light, 58% flat, bulk, contract	100 lb.	1.25 -	....
bags, contract	100 lb.	1.38 -	....
Soda ash, dense, bulk, contract, basis 58%	100 lb.	1.35 -	....
bags, contract	100 lb.	1.45 -	....
Soda, caustic, 76%, solid, drums contract	100 lb.	3.10 -	....
Soda, caustic, ground and flake, contracts, dr.	100 lb.	3.50 -	3.85
Soda, caustic, solid, 76% f. a.s. N. Y.	100 lb.	3.00 -	....
Sodium acetate, works, bbl.	lb.	.05 -	.05½
Sodium bicarbonate, bulk	100 lb.	1.75 -	....
330-lb. bbl.	100 lb.	2.00 -	....
Sodium bichromate, casks	lb.	.07½-	.07½
Sodium bisulphate (niter cake)	ton	6.00 -	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½-	.04½
Sodium chlorate, kegs	lb.	.06½-	.07
Sodium chloride	long ton	12.00 -	13.00
Sodium cyanide, cases	lb.	.19 -	.22
Sodium fluoride, bbl.	lb.	$0.08½-	$0.10
Sodium hyposulphite, bbl.	lb.	.02½-	.02½
Sodium nitrite, casks	lb.	.08½-	.08½
Sodium peroxide, powd., cases	lb.	.28 -	.30
Sodium phosphate, dibasic, bbl.	lb.	.03½-	.03½
Sodium prussiate, yel. bbl.	lb.	.09½-	.10½
Sodium salicylic, drums	lb.	.38 -	.40
Sodium silicate (40°, drums)	100 lb.	.75 -	1.15
Sodium silicate (60°, drums)	100 lb.	1.75 -	2.00
Sodium sulphide, fused, 60-62% drums	lb.	.03½-	.03½
Sodium sulphite, crys., bbl.	lb.	.02½-	.03
Strontium nitrate, powd., bbl.	lb.	.10 -	.10½
Sulphur chloride, yel drums.	lb.	.04½-	.05
Sulphur, crude	ton	18.00 -	20.00
At mine, bulk	ton	16.00 -	18.00
Sulphur, flour, bag	100 lb.	2.25 -	2.35
Sulphur, roll, bag	100 lb.	2.00 -	2.10
Sulphur dioxide, liquid, cyl.	lb.	.08 -	.08
Tin bichloride, bbl.	lb.	.13½-	....
Tin oxide, bbl.	lb.	.48 -	....
Tin crystals, bbl.	lb.	.35 -	....
Zinc carbonate, bags	lb.	.14 -	.14½
Zinc chloride, gran, bbl.	lb.	.05 -	.05½
Zinc cyanide, drums	lb.	.36½-	.37
Zinc dust, bbl	lb.	.08 -	.08½
Zinc oxide, lead free, bag	lb.	.07½-	....
5% lead sulphate, bags	lb.	.07½-	....
10 to 35 % lead sulphate, bags	lb.	.07 -	....
French, red seal, bags	lb.	.09½-	....
French, green seal, bags	lb.	.10½-	....
French, white seal, bbl.	lb.	.12 -	....
Zinc sulphate, bbl.	100 lb.	3.00 -	3.25

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.60 -	$0.65
Alpha-naphthol, ref., bbl.	lb.	.75 -	.80
Alpha-naphthylamine, bbl.	lb.	.35 -	.36
Aniline oil, drums	lb.	.16 -	.16½
Aniline salt, bbl.	lb.	.22 -	.23
Anthracene, 80%, drums	lb.	.75 -	.80
Anthraquinone, 25%, paste, drums	lb.	.75 -	.80
Benzaldehyde U.S.P., carboys	lb.	1.50 -	....
f.f.e. drums	lb.	1.60 -	....
tech, drums	lb.	68	.72
Benzene, pure, water-white, tanks, works	gal.	.25 -	....
Benzene, 90%, tanks, works	gal.	.23 -	....
Benzidine base, bbl.	lb.	.80 -	.82
Benzidine sulphate, bbl.	lb.	.70 -	.72
Benzoic acid, U.S.P., kegs	lb.	.82 -	85
Benzoate of soda, U.S.P., bbl.	lb.	.67 -	.72
Benzyl chloride, 95-97%, ref., carboys	lb.	.35 -	....
Benzyl chloride, tech., drums	lb.	.25 -	....
Beta-naphthol, tech., bbl.	lb.	.24 -	.25
Beta-naphthylamine, tech.	lb.	.65 -	.70
Cresol, U.S.P., drums	lb.	.22 -	.26
Ortho-cresol, drums	lb.	.28 -	.32
Cresylic acid, 97%, works drums	gal.	.65 -	.70
95-97%, drums, works	gal.	.60 -	.65
Dichlorbenzene, drums	lb.	.07 -	.08
Diethylaniline, drums	lb.	.55 -	....
Dimethylaniline, drums	lb.	.36 -	.38
Dinitrobenzene, bbl.	lb.	.15 -	.17
Dinitrochlorbenzene, bbl.	lb.	.21 -	.22
Dinitronaphthalen, bbl.	lb.	.30 -	.32
Dinitrophenol, bbl.	lb.	.35 -	.40
Dinitrotoluen, bbl.	lb.	.18 -	.20
Dip oil, 25%, drums	gal.	.26 -	.28
Diphenylamine, bbl.	lb.	.48 -	.50
H-acid, bbl.	lb.	.72 -	.75
Meta-phenylenediamine, bbl.	lb.	.95 -	1.00
Michlers ketone, bbl.	lb.	3.00 -	3.50
Monochlorbenzene, drums	lb.	.08 -	.10
Monoethylaniline, drums	lb.	.95 -	1.10
Naphthalene, flake, bbl.	lb.	.05 -	.05½
Naphthalene, balls, bbl.	lb.	.06 -	.06½
Naphthionate of soda, bbl.	lb.	.60 -	.65
Naphthionic acid, crude, bbl.	lb.	.60 -	.62
Nitrobenzene, drums	lb.	.09 -	.09½
Nitro-naphthalene, bbl.	lb.	.25 -	.30
Nitro-toluene, drums	lb.	.13½-	.14
N-W acid, bbl.	lb.	1.00 -	1.05
Ortho-amidophenol, kegs	lb.	2.40 -	2.50
Ortho-dichlorbenzene, drums	lb.	.12 -	.13
Ortho-nitrophenol, bbl.	lb.	1.25 -	1.30
Ortho-nitrotoluene, drums	lb.	.11 -	.12
Ortho-toluidine, bbl.	lb.	.12 -	.13
Para-aminophenol, base, kegs	lb.	1.20 -	1.25
Para-aminophenol, HCl, kegs	lb.	1.30 -	1.40
Para-dichlorbenzene, bbl.	lb.	.17 -	20
Paranitraniline, bbl.	lb.	.68 -	.70
Para-nitrotoluene, bbl.	lb.	.58 -	.60
Para-phenylenediamine, bbl.	lb.	1.40 -	1.50
Para-toluidine, bbl	lb.	.72 -	.80
Phthalic anhydride, bbl.	lb.	.30 -	.34
Phenol, U.S.P., dr.	lb.	.26 -	.28
Picric acid, bbl.	lb.	.20 -	.22
Pitch, tanks, works	ton	25.00 -	30.00
Pyridine, imp., drums	gal.	5.25 -	5.50
Resorcinol, tech., kegs	lb.	1.30 -	1.40

Resorcinol, pure, kegs	lb.	$1.90	$2.00
R-salt, bbl	lb.	.55	.60
Salicylic acid, tech., bbl	lb.	.31	.32
Salicylic acid, U.SP., bbl	lb.	.35	..
Solvent naphtha, water-white, tanks	gal.	.25	....
Crude, tanks	gal.	.22	....
Sulphanilic acid, crude, bbl	lb.	.16	.18
Tolidine, bbl	lb.	1.00	1.05
Toluidine, mixed, kegs	lb.	.30	.35
Toluene, tank cars, works	gal.	.26	....
Toluene, drums, works	gal.	.30	....
Xylidine, drums	lb.	.48	.50
Xylene, 5 deg.-tanks	gal.	.40	....
Xylene, com., tanks	gal.	.28	....

Naval Stores

Rosin B-D, bbl. 280 lb.		$5.60	$5.70
Rosin E-I, bbl. 280 lb.		5.75	....
Rosin K-N, bbl. 280 lb.		5.90	6.10
Rosin W.G.-W.W., bbl. 280 lb.		7.00	7.60
Wood rosin, bbl. 280 lb.		5.80	5.90
Turpentine, spirits of, bbl	gal.	.88	.....
Wood, steam dist., bbl	gal.	.85	.....
Wood, dest. dist., bbl	gal.	.67	.....
Pine tar pitch, bbl. 200 lb.		5.50	.....
Tar, kiln burned, bbl. 500 lb.		10.50	.....
Retort tar, bbl. 500 lb.		10.50	.....
Rosin oil, first run, bbl	gal.	.41	.....
Rosin oil, second run, bbl	gal.	.45	.....
Rosin oil, third run, bbl	gal.	.47	.....
Pine oil, steam dist	gal.	.65	.....
Pine tar oil, ref	gal.	.50	.....

Animal Oils and Fats

Degras, bbl	lb.	$0.03½	$0.05½
Grease yellow, loose	lb.	.06½	.06½
Lard oil, Extra No. 1, bbl	gal.	.85	.....
Lard compound, bbl	lb.	.11½	.11½
Neatsfootoil 20 deg. bbl	gal.	1.26	.....
No. 1, bbl	gal.	.86	.88
Oleo Stearine	lb.	.10	.....
Oleo oil, No. 1, bbl	lb.	.12½	.....
Red oil, distilled, d.p. bbl	lb.	.08½	.09½
Saponified, bbl	lb.	.08½	.09½
Tallow, extra, loose works	lb.	.07	.....
Tallow oil, acidless, bbl	gal.	.82	.....

Vegetable Oils

Castor oil, No. 3, bbl	lb.	$0.15½	.....
Castor oil, No. 1, bbl	lb.	.16	.....
Chinawood oil, bbl	lb.	.13½	.14½
Coconut oil, Ceylon, bbl	lb.	.09½	.09½
Ceylon, tanks, N.Y.	lb.	.08½	.08½
Coconut oil, Cochin, bbl	lb.	.09½	.....
Corn oil, crude, bbl	lb.	.10	.10½
Crude, tanks, (f.o.b. mill)	lb.	.08½	.....
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.08	.....
Summer yellow, bbl	lb.	.09½	.....
Winter yellow, bbl	lb.	.11	.11½
Linseed oil, raw, car lots, bbl.	gal.	.94	.....
Raw, tank cars (dom.)	gal.	.88	.....
Boiled, cars, bbl. (dom.)	gal.	.96	.....
Olive oil, denatured, bbl	gal.	1.20	1.25
Sulphur, (foots) bbl	lb.	.09½	.09½
Palm, Lagos, casks	lb.	.07	.07½
Niger, casks	lb.	.06½	.....
Palm kernel, bbl	lb.	.08½	.09½
Peanut oil, crude, tanks (mill)	lb	.11	.....
Peanut oil, refined, bbl	lb.	.14½	.14½
Perilla, bbl	lb.	.14	.14½
Rapeseed oil, refined, bbl	gal.	.81	.82
Sesame, bbl	lb.	.11	.11½
Soya bean (Manchurian), bbl.	lb.	.11½	.....
Tank, f.o.b. Pacific coast	lb.	.09½	.10
Tank, (f.o.b. N.Y.)	lb.	.10½	....

Fish Oils

Cod, Newfoundland, bbl	gal.	$0.60	$0.62
Menhaden, light pressed, bbl.	gal.	.58	.....
White bleached, bbl	gal.	.60	.....
Blown, bbl	gal.	.64	.....
Crude, tanks (f.o.b. factory)	gal.	.47½	.50
Whale No. 1 crude, tanks, coast	lb.	.....	.....
Winter, natural, bbl	gal.	.75	.76
Winter, bleached, bbl	gal.	.78	.79

Oil Cake and Meal

Coconut cake, bags	ton	$28.00	29.00
Cottonseed meal, f.o.b. mills	ton	34.00	35.00
Linseed cake, bags	ton	33.00	34.00
Linseed meal, bags, spot	ton	39.00	41.00

Dye & Tanning Materials

Albumen, blood, bbl	lb.	$0.50	$0.55
Albumen, egg, tech, kegs	lb.	.95	.97
Cochneal, bags	lb.	.32	.34
Cutch, Borneo, bales	lb.	.04½	.04½
Cutch, Rangoon, bales	lb.	.13½	.14½
Dextrine, corn, bags 100 lb.		3.64	3.91
Dextrine gum, bags 100 lb.		3.99	4.09
Divi-divi, bags	ton	40.00	42.00
Fustic, sticks	ton	30.00	35.00
Fustic, chips, bags	lb.	.04	.05
Gambier com., bags	lb.	.12	.13
Logwood, sticks	ton	25.00	26.00
Logwood, chips, bags	lb.	.02½	.03
Sumac, leaves, Sicily, bags	ton	.....	.....
Sumac, ground, bags	ton	160.00	170.00
Sumac, domestic, bags	ton	50.00	55.00
Starch, corn, bags 100 lb.		3.07	3.33
Tapioca flour, bags	lb.	.05½	.06½

Extracts

Archil, cone., bbl	lb.	$0.16½	$0.20
Chestnut, 25% tannin, tanks	lb.	.01½	.02½
Divi-divi, 25% tannin, bbl	lb.	.04	.05
Fustic, crystals, bbl	lb.	.20	.22
Fustic, liquid, 42°, bbl	lb.	.08	.09
Gambier, liq., 25% tannin, bbl.	lb.	.09½	.10
Hematine crys., bbl	lb.	.14	.18
Hemlock, 25% tannin, bbl	lb.	.03½	.04
Hypernic, solid, drums	lb.	.24	.26
Hypernic, liquid, 51°, bbl	lb.	.09½	.10½
Logwood, crys., bbl	lb.	.14	.15
Logwood, liq., 51°, bbl	lb.	.08	.09
Osage Orange, 51°, liquid, bbl.	lb.	.07	.08
Osage Orange, powder, bg.	lb.	.14	.15
Quebracho, solid, 65% tannin, bbl	lb.	.05	.05½
Sumac, dom., 51°, bbl	lb.	.07	.07½

Dry Colors

Blacks–Carbongas, bags, f.o.b. works, contract	lb.	$0.09	$0.11
spot, cases	lb.	.12	.16
Lampblack, bbl	lb.	.12	.40
Mineral, bulk	ton	35.00	45.00
Blues–Bronze, bbl	lb.	.38	.40
Prussian, bbl	lb.	.38	.40
Ultramarine, bbl	lb.	.08	.35
Browns, Sienna, Ital., bbl	lb.	.06	.14
Sienna, Domestic, bbl	lb.	.03½	.04
Umber, Turkey, bbl	lb.	.04	.04½
Greens–Chrome, C.P.Light, bbl	lb.	.28	.30
Chrome, commercial, bbl	lb.	.11½	.12
Paris, bulk	lb.	.26	.27
Reds, Carmine No. 40, tins	lb.	4.25	4.50
Iron oxide red, casks	lb.	.08	.12
Para toner, kegs	lb.	1.00	1.10
Vermilion, English, bbl	lb.	1.35	1.40
Yellow, Chrome, C.P. bbls	lb.	.17	.18
Ocher, French, casks	lb.	.02½	.03

Waxes

Bayberry, bbl	lb.	$0.20	$0.21
Beeswax, crude, Afr. bg	lb.	.24½	.25
Beeswax, refined, light, bags	lb.	.32	.34
Beeswax, pure white, cases	lb.	.40	.41
Candellila, bags	lb.	.23	.23½
Carnauba, No. 1, bags	lb.	.38	.39
No. 2, North Country, bags	lb.	.29	.30
No. 3, North Country, bags	lb.	.21½	.22½
Japan, cases	lb.	.24	.25
Montan, crude, bags	lb.	.05½	.06
Paraffine, crude, match, 105-110 m.p., bbl	lb.	.05½	....
Crude, scale 124-126 m.p. bags	lb.	.04½	.05
Ref., 118-120 m.p., bags	lb.	.05½	....
Ref., 123-125 m.p., bags	lb.	.05½	....
Ref. 128-130 m.p., bags	lb.	.05½	....
Ref., 133-135 m.p., bags	lb.	.06	....
Ref., 135-137 m.p., bags	lb.	.06½	.07
Stearic acid, agle pressed, bags	lb.	.11	.11½
Double pressed, bags	lb.	.11½	.11½
Triple pressed, bags	lb.	.13	.13½

Fertilizers

Acid phosphate, 16%, bulk, works	ton	$7.50	$7.75
Ammonium sulphate, bulk f.o.b. works 100 lb.		2.60	.....
Blood, dried, bulk	unit	4.10	4.15
Bone, raw, 3 and 50, ground	ton	26.00	28.00
Fish scrap, dom., dried, wks.	unit	.....	.....
Nitrate of soda, bags 100 lb.		2.50	.....
Tankage, high grade, f.o.b. Chicago	unit	2.20	.....
Phosphate rock, f.o.b. mines			
Florida pebble, 68-72%	ton	3.40	.....
Tennessee, 75%	ton	6.75	7.00
Potassium muriate, 80%, bags	ton	34.55	.....
Potassium sulphate, bags basis 90%	ton	45.85	.....
Double manure salt	ton	26.35	.....
Kainit	ton	7.22	.....

Crude Rubber

Para—Upriver fine	lb.	$0.19	.....
Upriver coarse	lb.	.13½	.....
Upriver caucho ball	lb.	.14	.14½
Plantation—First latex crepe	lb.	.19½	.....
Ribbed smoked sheets	lb.	.19	.....
Amber crepe No. 1	lb.	.19½	.....

Gums

Copal, Congo, amber, bags	lb.	$0.09	$0.14
East Indian, bold, bags	lb.	.14	.15
Manila, pale, bags	lb.	.18	.19
Pontinak, No. 1 bags	lb.	.19	.20
Damar, Batavia, cases	lb.	.23	.23½
Singapore, No. 1, cases	lb.	.28	.29
Singapore, No. 2, cases	lb.	.19½	.20
Kauri, No. 1, cases	lb	.60	.65
Ordinary chips, cases	lb.	.21	.22
Manjak, Barbados, bags	lb.	.08	.11

Shellac

Shellac, orange fine, bags	lb.	$0.56	$0.57
Orange superfine, bags	lb.	.58	....
A. C. garnet, bags	lb.	.52	....
Bleached, bonedry	lb.	.64	.....
Bleached, fresh	lb.	.53	.54
T. N., bags	lb.	.54	.55

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$300.00	$400.00
Asbestos, shingle, f.o.b., Quebec	sh. ton	50.00	70.00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00	25.00
Barytes, grd, white, f.o.b. mills, bbl	net ton	16.00	17.00
Barytes, grd., off-color, f.o.b. Balt	net ton	13.00	14.00
Barytes, floated, f.o.b. St. Louis, bbl	net ton	23.00	24.00
Barytes, crude f.o.b. mines, bulk	net ton	8.00	8.50
Casein, bbl., tech	lb.	.10½	.11½
China clay (kaolin) crude, No. 1, f.o.b. Ga	net ton	7.00	8.00
Washed, f.o.b. Ga	net ton	8.50	9.00
Powd., f.o.b. Ga	net ton	14.00	20.00
Crude f.o.b. Va	net ton	6.00	8.00
Ground, f.o.b. Va	net ton	13.00	19.00
Imp., lump, bulk	net ton	15.00	20.00
Imp., powd	net ton	45.00	50.00
Feldspar, No. 1 f.o.b.N.C.	long ton	7.00	7.50
No. 2 f.o.b.N.C.	long ton	4.50	5.00
No. 1 soap	long ton	7.00	.....
No. 1 Canadian, f.o.b. mill, powd	long ton	20.00	.....
Graphite, Ceylon, lump, first quality, bbl	lb.	.05½	.06
Ceylon, chip, bbl	lb.	.04½	.05
High grade amorphous crude	ton	15.00	35.00
Gum arabic, amber, sorts, bags	lb.	.12½	.13
Gum tragacanth, sorts, bags	lb.	.48	.50
No. 1, bags	lb.	1.20	.....
Kieselguhr, f.o.b. Cal	ton	40.00	42.00
F.o.b. N. Y	ton	50.00	55.00
Magnesite, calcined, f.o.b. Cal.	ton	35.00	45.00
Pumice stone, imp., casks	lb.	.03	.40
Dom., lump, bbl	lb.	.06	.08
Dom., ground, bbl	lb.	.03	.05
Silica, glass sand, f.o.b. Ind	ton	2.00	2.50
Silica, sand blast, f.o.b. Ind	ton	2.25	3.50
Silica, amorphous, 200-mesh, f.o.b. Ill	ton	20.00	.....
Silica, glass sand, f.o.b. Ill	ton	1.75	3.00
Soapstone, coarse, f.o.b. Vt., bags	ton	7.50	8.00
Talc, 200 mesh, f.o.b., Vt., bags, extra	ton	10.50	.....
Talc, 200 mesh, f.o.b. Ga., bags	ton	8.00	12.00
Talc, 325 mesh, f.o.b. New York, grade A bags	ton	14.75	.....

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3.75	$4.25
Corning	bbl.	2.15	....
Cabell	bbl.	1.95	....
Somerset	bbl.	2.05	2.25
Illinois	bbl.	2.07	.....
Indiana	bbl.	2.08	.....
Kansas and Okla. under 28 deg.	bbl.	1.00	.....
California, 35 deg. and up	bbl.	1.40	.....

Gasoline, Etc.

Motor gasoline, steel bbls	gal.	$0.20	.....
Naphtha, V. M. & P. deod, steel bbls	gal	.19	....
Kerosene, ref tank wagon	gal.	.14½	.15
Bulk, W.W. delivered, N.Y.	gal.	.08½	.....
Lubricating oils:			
Cylinder, Penn., filtered	gal.	.31	.37
Bloomless, 30@31 grav	gal.	.22	.23
Paraffin, pale 885 vis	gal.	.17	.17½
Spindle, 200, pale	gal.	.22	.....
Petrolatum, amber, bbls	lb.	.04½	.04½
Paraffine wax (see waxes)			

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	1,000	$140	$145
Chrome brick, f.o.b. Eastern shipping points	ton	45	47
Chrome cement, 40-50% Cr_2O_3	ton	23	27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00	
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks	1,000	42	45
2nd. quality, 9-in. shapes, f.o.b. wks	1,000	35	38
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65	68
9-in. arches, wedges and keys	ton	80	85
Scraps and splits	ton		85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48	50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48	50
F.o.b. Mt. Union, Pa	1,000	38	40
Silicon carbide refract. brick, 9-in.	1,000	1,180.00	

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00	.....

Ferrochromium, per lb. of Cr, 1-2% C	lb.	$0 30	-
4-6% C	lb.	.11½	-
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	107.50	-
Spiegeleisen, 19-21% Mn	gr. ton	38.00	- 40.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	2.00	- 2.25
Ferrosilicon, 10-12%	gr. ton	41.50	- 46.50
50%	gr. ton	75.00	-
Ferrotungsten, 70-80%, per lb. of W	lb.	.85	- .95
Ferro-uranium, 35-50%, of U, per lb. of U	lb.	4.50	-
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50	- 4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$5.50	- $8.75
Chrome ore Calif. concentrates, 50% min. Cr_2O_3	ton	22.00	-
C.i.f. Atlantic seaboard	ton	19 00	- 22.00
Coke, fdry., f.o.b. ovens	ton	4.50	- 5.00
Coke, furnace, f.o.b. ovens	ton	3.30	- 3.40
Fluorspar, gravel, f.o.b. mines, Illinois	ton	23.50	-
Ilmenite, 52% TiO_2 Va	lb.	.01½	-
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.42	- .46
Manganese ore, chemica (MnO_2)	ton	75.00	- 80.00
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y	lb.	.80	-
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06	- .08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½	- .12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½	- .12
Pyrites, dom. fines, f.o.b. mines, Ga	unit	.12	-
Rutile, 95% TiO_2	lb.	.12	- .15
Tungsten, scheelite, 60% WO_3 and over	unit	9.25	-
Tungsten, wolframite, 60% WO_3	unit	9.00	- 9.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50	- 3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	12.25	- 2.50
Vanadium pent oxide, 99%	lb.	2.00	- 14.00
Vanadium ore, per lb. V_2O_5	lb.	1 00	- 1.25
Zircon, 99%	lb.	.06	- .07

Non-Ferrous Metals

Copper, electrolytic	lb.	$0.12½	- $0.12¾
Aluminum, 98 to 99%	lb.	.27	- .28
Antimony, wholesale, Chinese and Japanese	lb.	.08½	- .08¾
Nickel, 99%	lb.	.27	- .30
Monel metal, shot and blocks	lb.	.32	
Tin, 5-ton lots, Straits	lb.	.41¾	
Lead, New York, spot	lb.	.07	
Lead, E. St. Louis, spot	lb.	.06¾	
Zinc, spot, New York	lb.	.0615	
Zinc, spot, E. St. Louis	lb.	.0580	
Silver (commercial)	oz.	.66¾	
Cadmium	lb.	.60	
Bismuth (500 lb. lots)	lb.	2.35-2.40	
Cobalt	lb.	2.50-3.00	
Magnesium, ingots, 99%	lb.	.90-.95	
Platinum, refined	oz.	116 00	
Iridium	oz.	260 00-270.00	
Palladium	oz.	78 00-83.00	
Mercury	75 lb.	75.00-76.00	
Tungsten powder	lb.	.95-1.00	

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	19.25
Copper bottoms	29.25
Copper rods	19.75
High brass wire	17.75
High brass rods	15.00
Low brass wire	19.50
Low brass rods	20 50
Brazed bronze tubing	24.34
Seamless copper tubing	22.75
Seamless high brass tubing	21.50

OLD METALS—The following are the dealers purchasing prices in cents per pound

Copper, heavy and crucible	10.50 @ 10.75
Copper, heavy and wire	10.00 @ 10.12½
Copper, light and bottoms	8.50 @ 8.62½
Lead, heavy	5.75 @ 6 00
Lead, tea	4.00 @ 4 25
Brass, heavy	6.00 @ 6.25
Brass, light	4.75 @ 4 87½
No. 1 yellow brass turnings	6 50 @ 6.75
Zinc scrap	3.50 @ 3.75

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.49	$3.49
Soft steel bars	3.49	3.49
Soft steel bar shapes	3.59	3.59
Soft steel bands	4.39	4.39
Plates, ¼ to 1 in. thick	3 59	3.59

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Alabama

BESSEMER—The Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa., is perfecting plans for the early erection of a new plant on 14-acre tract of land near the city acquired a number of months ago. The initial works will comprise a number of buildings, six kilns, machine shop, power house and auxiliary structures, and will be equipped for a capacity of about 30,000 firebrick and refractory shapes per day. It will give employment to about 125 men. The new plant will cost approximately $250,000, and is expected to be ready for service early in the coming year.

CRICHTON—The Mobile Paper Mills, Inc., Mobile, Ala., has work under way on its proposed new plant at Crichton, near Mobile, to occupy a tract of land recently acquired. The main building will be 1-story, 250x350 ft., with power house and storage building adjoining. Contract for erection has been let to the Mobile Steel Co. The plant will be equipped for extensive capacity and is estimated to cost in excess of $250,000. J. M. Walsh is president.

Arizona

PHOENIX—The Industrial Chemical Co., Phœnix, has awarded a general contract to the T. B. Stewart Construction Co., Bank of Italy Bldg., Los Angeles, Calif., for the erection of its proposed local plant on site acquired several weeks ago. It will be 1-story, 60x150 ft., and is estimated to cost $30,000. Work will be placed in progress at once.

California

SAN DIEGO—The Vitrified Products Co. is arranging plans for an addition to its plant in the Old Town section, including four additional kilns and considerable equipment for the manufacture of brick and tile products. The expansion will cost about $75,000, including equipment.

BERKELEY—The Berkeley Steel Construction Co. has begun the erection of a new foundry at 2nd and Camilla Sts., in conjunction with machine shop and other structures, to be equipped for the production of steel castings. T. S. Neilson is president and general manager.

COALINGA—H. R. Palmer, Los Angeles, is perfecting plans for the organization of a company for the erection of a plant for the development of magnesite products on tract of land acquired near Coalinga, known as Sampson Peak. The works will include a complete mining and commercial reduction plant, for which estimates of cost are now being made.

EMERYVILLE—The Pacific Malleable Castings Co. has commenced the construction of a new foundry on site near the Elmhurst Station, Emeryville, totaling about 55,000 sq.ft. of floor area, and plans for the early installation of equipment.

Connecticut

BRIDGEPORT—The Bridgeport Safety Emery Wheel Co., manufacturer of abrasive materials, has awarded a general contract to W. R. Muirhead & Son, Bridgeport, for the erection of a new 1-story plant at Stratford, Conn., 90x240 ft., on which work will proceed at once.

MIDDLETOWN—The Standard Oil Co. of New York, Inc., has completed plans and will soon begin the erection of a new storage and distributing plant on the River Rd., estimated to cost close to $800,000, with equipment.

Florida

DE LAND—Plans are being considered by the Town Council for the installation of a municipal artificial gas plant. It is purposed to secure estimates of cost and arrange a bond issue at an early date. The local Commercial Club is interested in the project.

TAMPA—The Board of City Commissioners is taking bids until June 24 for the installation of additional equipment at the waterworks to provide for a new supply from the Hillsborough River, including filtration and chemical equipment, with chemical feed operator, operating tables, rate controller, pipe, valves, etc., for complete water treatment. Nicholas S. Hill, Jr., 112 East 19th St., New York, is consulting engineer.

Idaho

TWIN FALLS—W. J. Millsap, Twin Falls, and associates have tentative plans under way for the establishment of a local plant for the manufacture of cement tiles and kindred products. The initial works are expected to cost about $25,000, with equipment.

Illinois

CHICAGO—The American Envelope Co., 817 West Washington St., manufacturer of paper products, is planning to take bids in the near future for a 1-story and basement plant on Grand Ave., near Kedzie Ave., estimated to cost $100,000, with machinery. L. E. Russell, 25 North Dearborn St., is architect. H. G. Steinson secretary and treasurer.

Indiana

INDIANAPOLIS—The Standard Sanitary Mfg. Co., Bessemer Bldg., Pittsburgh, Pa., manufacturer of enameled iron sanitary ware, etc., has rejected bids recently received for the erection of its proposed 4-story factory branch and distributing works, 80x150 ft., at Pratt and Senate Sts., and will have revised plans drawn. New bids will be called during the summer. The plant is estimated to cost $175,000. The Hunting-Davis Co., Century Bldg., Pittsburgh, is architect.

Iowa

CEDAR RAPIDS—Penick & Ford, Ltd., Whitney Bldg., New Orleans, La., manufacturer of sugar products, starch, etc., is having plans drawn for several additions to its local plant, to total about $1,500,000. A 4-story and basement factory, 110x170 ft., will be built for crystal sugar service, to cost $1,250,000 with machinery. The latter will consist of 96 crystallizers, 80 centrifugals, tank coolers, driers, separators, fans, heaters, etc. Another 4-story structure will be constructed, 62x110 ft., for starch-packing service, to cost about $100,000, while a third building, 6-story, 65x80 ft., will be erected for lump starch production, with installation to include mills, mixers, presses, conveyors and auxiliary equipment; it will cost approximately $250,000. Fred Friedline, Kentland, Ind., and care of Pullman Hotel, Cedar Rapids, is engineer and architect.

Kansas

LYONS—The American Salt & Coal Co., Waldheim Bldg., Kansas City, Mo., has tentative plans under advisement for the erection of a new salt evaporation plant at its local works, to operate under vacuum process. It will be 1- and 3-story, 200x500 ft., and is estimated to cost close to $850,000, including equipment.

Kentucky

ASHLAND—The Ashland Clay & Metal Products Co. is said to have preliminary plans under advisement for a new plant in the Bellefonte Crossing section, to include a 1-story foundry for the production of gray iron castings. The entire works will cost about $35,000. Leo Meehan is one of the heads of the company.

Louisiana

BATON ROUGE—The Texas Chemical Co., Houston, Tex., is said to be perfecting plans for the erection of the initial unit of its proposed local plant on 80-acre site near the city, acquired several months ago. It will consist of a main building, power house and auxiliary structures. The entire plant will cost in excess of $500,000, with machinery.

Maryland

BALTIMORE—The Carr-Lowrey Glass Co., Westport, Baltimore, has taken title to a tract of property adjoining its works on Kloman St., secured for a consideration

of $55,000, and is said to be planning for the erection of a new addition. The company specializes in the manufacture of bottles and other hollowware.

BALTIMORE — The Standard Oil Co. of New Jersey, St. Paul Pl., has plans and will soon begin the erection of a new storage and distributing plant at 1st Ave. and 8th St., consisting of a number of buildings, estimated to cost $100,000, with equipment.

Michigan

DETROIT—The Detroit Graphite Co., 518 12th St., manufacturer of paints, etc., has plans for the erection of a 1-story building on Fort St., near 12th St., estimated to cost $20,000.

Missouri

SEDALIA—The American Disinfecting Co., 304 West Main St., manufacturer of disinfectants, etc., has completed plans and will soon begin the erection of a new plant at Main and Prospect Sts., to be 2-story, 80x95 ft. Clifford H. Johnson, Citizens National Bank Bldg., is architect.

ST. LOUIS—The Steelcote Mfg. Co., 700 North 1st St., manufacturer of paints, etc., has superstructure work in progress on a new 3-story and basement addition, 60x100 ft., to more than double the present output, for which a general contract was awarded recently to the J. H. Bright Building & Contracting Co., St. Louis. It will cost approximately $150,000, with equipment.

New York

BUFFALO — The Hendon Chemical Co., care of the Combustion Utilities Co., 8 Bridge St., New York, engineer, has plans under way and purposes to begin work in about 60 days on its proposed plant on the River Rd., for the manufacture of chemical specialties, estimated to cost in excess of $600,000, with machinery. Bids will soon be asked.

BUFFALO — The Buffalo Sintering Co., recently organized, has applied to the city council for permission to construct and operate a plant on Marilla St., near the line of the South Buffalo R.R., for which site has been purchased. The plant will be given over to the production of metal products from iron bearings materials too small for blast furnace operation.

PENN YAN—The mill of the Penn Yan Board & Paper Co. has been acquired by Henry Frost and associates at a foreclosure sale. The new owners are said to be planning to operate the plant, and will make improvements and modernize the mill in different departments for pulp manufacture.

Ohio

NORWOOD—The Shepard Chemical Co. has filed plans for the erection of a 1-story plant on Highland Ave. between Lester Rd. and Beech St., and will proceed with work at once.

DAYTON—The Board of Education, G. J. Schmidt, clerk and treasurer, is taking bids until June 10 for school equipment for the new Roosevelt high school, including apparatus for the chemistry department, physics laboratory, and clay-modeling department, as per specifications on file. Schenck & Williams, Dayton, are architects.

Oklahoma

BARTLESVILLE — The Phillips Petroleum Co., Bartlesville, has acquired the gasoline-refining plants of the National Gasoline Co., situated at Wewoka, Okla.; Pioneer and Breckenridge, Tex., with combined daily output of 60,000 gal. The acquisition includes, also, tank cars and kindred equipment, the entire purchase representing a sum in excess of $500,000. The company has taken over, as well, the gasoline plant of the Claiborne Gasoline Co., at Homer, La., with rated output of 10,000 gal. daily. The new owner is said to have plans under way for improvements and extensions in the different plants to develop maximum capacities. E. R. Ratcliff is vice-president.

Pennsylvania

PHILADELPHIA—Charles Lennig & Co., Inc., 40 North Front St., manufacturer of hyposulphite of soda, basic acids, etc., has preliminary plans under way for the erection of an addition to its plant in the Bridesburg section for considerable increase in output.

CLY—The National Roofing Mfg. Co., York, Pa., has tentative plans under advisement for additions to its local plant, continuing its expansion program inaugurated a number of months ago, to include a 1-story extension to the beater department to develop about double the present capacity. It is purposed, also, to install another paper machine and auxiliary equipment. The plant specializes in the production of paper and prepared roofings. J. F. Young is president.

South Carolina

COLUMBIA—The Palmetto Concrete Mfg. Co., manufacturer of concrete pipe, etc., is planning for additions in its plant at Lincoln and Rice Sts., to include the installation of machinery for the casting of pipe of large and small diameter. T. K. Legare is vice-president and general manager.

Texas

HOUSTON—The South Texas Cotton Oil Co. has tentative plans under way for extensions and improvements in the local plant of the Magnolia Gas Products Co., recently acquired, as well as the branch works of the same company at Beaumont, Tex. The plants are devoted to the production of industrial oxygen and hydrogen gas, and will be developed to maximum capacity in these lines. At a later date it is purposed to construct an addition to the first-mentioned factory, to be equipped for the manufacture of soap products. The purchasing company has recently increased its capital to $1,000,000 for expansion. Jesse Andrews is president.

Virginia

RICHMOND—The Wortendyke Mfg. Co., manufacturer of paper products, has awarded a general contract to the Harrison Construction Co., Petersburg, Va., for the erection of a new 2-story mill at 13th and Byrd Sts., totaling about 70,000 sq.ft. of floor area, estimated to cost $180,000, including equipment. Work will be placed in progress at once. Carneal & Johnson, Richmond, are architects.

Washington

EVERETT — The Dumor Chemical Co., Pioneer Bldg., Seattle, has tentative plans under consideration for the establishment of a local plant for the manufacture of a line of chemical specialties.

New Companies

LORNE, INC., 75 Montgomery St., Jersey City, N. J.; paints, varnishes, etc.; $50,000. Incorporators: Samuel M. Coombs, Jr., Henry A. Oetjen and Carl S. Kuebler.

PRO CHEMICAL LABORATORIES, INC., 4801 West Lake St., Chicago, Ill.; chemicals and chemical compounds; $40,000. Incorporators: D. P. Stafford, L. A. and O. L. Prohaska.

STAR WATER MFG. CO., Waterbury, Conn.; bleaching and washing compounds; $100,000. Incorporators: Emile, Homer and Leo Archambault, 1 Post St., Waterbury.

AUTOLINE OIL CO., Dock and Caroline Sts., Baltimore, Md.; refined petroleum products; $1,024,500. Incorporators: Roger B. Williams, Albert E. Donaldson and John Lewin.

SHERWOOD WAXED PAPER CO., New York, care of the Corporation Trust Co. of Delaware, Dover, Del., representative; waxed and other processed papers; $500,000. Incorporators: Morgan A. Jones, New York; Sherman A. Jones, Cambridge, Mass.; and James J. Roberts, Franklin Park, Mass.

THE TWO-WAY SALT CO., Los Angeles, Calif.; salt and affiliated products; $200,000. Incorporators: Herald McMillen, Samuel Johnston and Harold T. Williams. Representative: Fredericks & Hanna, 1126 Pacific Mutual Building, Los Angeles.

JOHN A. FISHER PRODUCTS CO., Dallas, Tex.; paper products; $100,000. Incorporators: John A. Fisher and Charles E. Gilpin, both of Dallas.

SUPERIOR GOLD INK MFG. CO., 296 Eddy St., Providence, R. I.; special inks and kindred products; organized. Frank S. Shapiro, 75 Glenham St., is head.

WIGGINS CHEMICAL CO., Winchester, Ky.; care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative; chemicals and chemical byproducts; $100,000. Incorporators: D. C. Wiggins, William J. Baxter and H. H. Moore, all of Winchester.

SIMPSON FIRE BRICK CO., Carbon, Ind.; firebrick and other refractory products; $100,000. Incorporators: J. W. Knipp, W. A. Houston and J. L. Sydenstricker, all Carbon.

TRIPLEX CHEMICAL CO., Brooklyn, N. Y.; chemicals and chemical byproducts; $30,000. Incorporators: D. C. Wiggins, Wil- Representative: Samuel Kahn, 63 Park Row, New York.

KING BEAR CHEMICAL CO., San Francisco, Calif.; chemicals and chemical compounds; $10,000. Incorporators: Clarence F. King, Louis C. Towne and Vincent M. Kemble. Representative: Edward J. Jose, 519 California St., San Francisco.

PAPER PRODUCTS CO OF NEW JERSEY, INC., Asbury Park, N. J.; paper specialties; $100,000. Incorporators: Alfred M. and J. Parker Hickman, 160 Railroad Ave., Asbury Park. The last noted is representative.

CALUMET PETROLEUM CO., East Chicago, Ind.; petroleum and byproducts; $100,000. Incorporators: C. M. Watson, M. O. Seifert and J. B. Creswell, all of East Chicago.

REFLECTO WASH & POLISH CO., New York; polishes, washing compounds, etc.; $25,000. Incorporators: B. Steinberg and S. Kesend. Representative: A. L. Simpson, 358 Fifth Ave., New York.

MACY MFG. CORP., New York; fiber products; $20,000. Incorporators: A. W. Macy, M. R. Alexander and J. J. Auernaan. Representative: L. R. Hanower, 1540 Broadway, New York.

BORDEN-FITZGERALD CO., 6447 Sheridan Rd., Chicago, Ill.; tile, mosaics, etc.; $10,000. Incorporators: Arthur H. Borden and John G. Fitzgerald.

W. G. & F. PROOFING CO., INC., New York; waterpoofing products, compounds, etc.; $10,000 and 1,000 shares common stock, no par value. Incorporators: T. A. O'Neil, R. W. Crawford and C. F. B. Roth. Representative: Campbell, Harding & Pratt, 43 Wall St., New York.

CINCINNATI-DEVOE BAKED ENAMELING CO., Norwood, O.; enameled products; $10,000. Incorporators: Lawrence J. Funke and Clifford C. Giese, both of Cincinnati.

WAY-GO CHEMICAL CO., Dallas, Tex.; chemicals and chemical byproducts; capital not stated. Incorporators: J. B. Lebow, William Thompson and C. A. Beerman, all of Dallas.

L. E. RODGERS MINERAL INDUSTRIES, INC., Central Life Bldg., Ottawa, Ill.; operate mining and refining plants for clay, shale and minerals; $350,000. Incorporators: Harry D. and Louis E. Rodgers.

ROSE CHEMICAL CO., New York; chemicals and chemical compounds; 1,000 shares of stock, no par value. Incorporators: J. H. Amen, R. N. West and P. W. Lowry. Representative; Sherman & Sterling, 55 Wall St., New York.

DONALD CHEMICAL CORP., New York, care of the United States Corporation Co., 65 Cedar St., New York, representative; chemicals and chemical byproducts; $300,000.

CHATTANOOGA OIL CO., Chattanooga, Tenn.; refined petroleum products; $220,000. Incorporators: B. F. Annis and F. J. Hackney, both of Chattanooga.

SEELEY & CO., INC., New York; chemicals and chemical byproducts; $10,000, and 500 shares common stock, no par value. Incorporators: M. J. Seeley and R. G. Smith. Clarence Kimball, 115 Broadway, New York.

LITT MFG CO., Trenton, N. J.; porcelain products; $10,000. Incorporators: Louis H. and Max Litt, 150 South Broad St., Trenton. The last noted is representative.

Industrial Notes

THE BUFFALO FORGE CO., of Buffalo, N. Y., announces the opening, on June 1, of a new Western office at Seattle, Wash. The territory of this office will include the states of Oregon, Idaho and Montana, in addition to that of Washington and the territory of Alaska. Arthur T. Forsyth of the Buffalo plant will be Western representative in charge.

At a meeting of the LEBANON IRON CO., Lebanon, Pa., William C. Sproul, former Governor of Pennsylvania, was elected chairman of the executive committee. A. H. Beale, formerly vice-president of the Sheet & Tube Co. of America, Chicago, Ill., has been elected president; and H. W. Pratt, former president of Naylor & Co., New York, has been elected vice-president. Howard Longstreth will continue as treasurer, and John C. Brown as general manager.

THE FEATHER-STONE INSULATION CO.'s headquarters are now at 611 East Fourth St., Los Angeles, Calif.

J. LAINSON WILLS removed his office and laboratory on May 1 to the Chemists Bldg., 50 East 41st St., New York.